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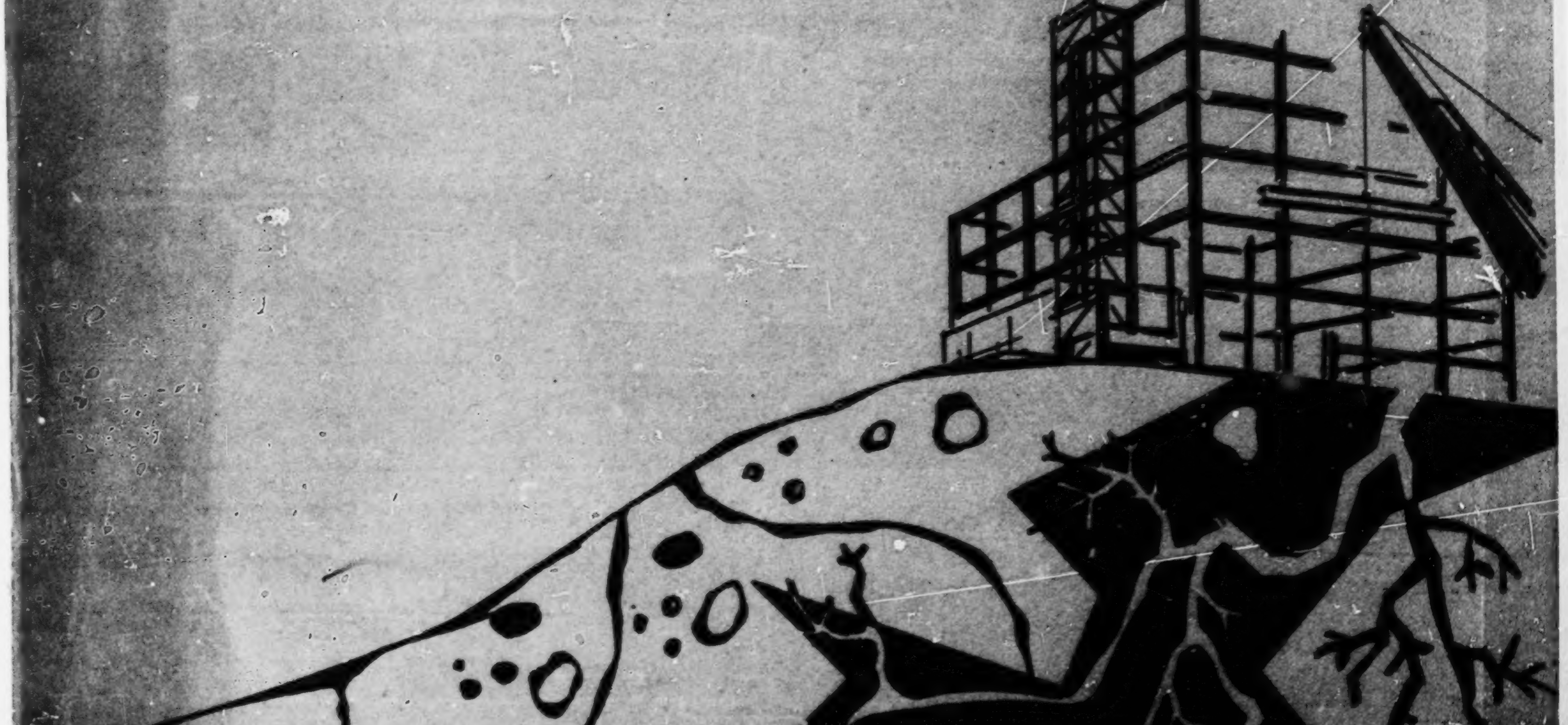

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URBAN SOIL EROSION AND SEDIMENT CONTROL

by the

NATIONAL ASSOCIATION OF COUNTIES
RESEARCH FOUNDATION
1001 Connecticut Avenue, N.W.
Washington, D. C. 20036

U.S. DEPARTMENT OF THE INTERIOR
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ABSTRACT

This study was conducted to determine the causes and the extent of urban and suburban soil erosion and sediment problems, and to describe ways in which local communities can organize and implement effective sedimentation control programs. An evaluation is provided on the state-of-the-art of urban sedimentation control, and a series of research needs in the sedimentation field is cited.

In addition, this report includes the "Community Action Guidebook for Soil Erosion and Sediment Control" which describes methods by which local governments can organize, plan, finance, staff, and implement urban sedimentation control programs. Aspects of areawide approaches, legal authority, and public support for sedimentation control are discussed, and an action plan is outlined.

It was found that soil erosion and sediment in developing areas is extensive, and that these problems pose significant threats to both soil and water resources. While many technical means for controlling sedimentation problems already exist, new administrative approaches are needed which accommodate the diversity of interests and pressures also associated with urban and suburban development.

Establishing control over urban and suburban sedimentation problems was found to require the involvement of several local groups and agencies, such as planning commissions, departments of public works, conservation districts, sanitation districts, and flood control districts. The pattern of involvement varied considerably throughout the nation. A task force management approach was considered to be successful in several instances.

This report is submitted in fulfillment of Grant 15030 DTL between the Federal Water Quality Administration and the National Association of Counties Research Foundation.

KEY WORDS: Sedimentation, Soil Erosion, Sediment, Urban Runoff, Watershed Management, Drainage Control

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SECTION I

INTRODUCTION

Sediment, in terms of sheer volume, ranks above domestic sewage, industrial wastes and chemicals as a major cause of water pollution. Annual sediment deposits in the nation's reservoirs, approximately 850,000 acre feet, are nearly five times the total volume excavated in building the entire Panama Canal. This amount pre-empts water storage capacity sufficient to provide an annual water supply for 5,500,000 people. Suspended solids, carried to the nation's streams by surface runoff, are estimated to be at least 700 times the volume of suspended solids in sewage discharge. In addition to filling stream channels, reservoirs, and estuaries, sediment causes expensive additional treatment of water supplies and reduces the oxygen content of water needed to assimilate wastes.

Sediment sources and amounts continually change with changing patterns of living. The nation's bourgeoning population growth has been reflected most vividly in expanding urban and suburban areas. Sediment yields from land undergoing redevelopment, development, and construction in these areas can be as much as five to 500 times greater than in rural areas.

This report is designed to present a survey of the scope and magnitude of the urban and suburban sediment problem, to indicate the current level of public action being taken to control it, to introduce a community action guidebook for control, and to outline research needs. This report, including recommendations and conclusions, is presented in three major parts: a state-of-the-art, the "Community Action Guidebook for Soil Erosion and Sediment Control," and research needs. The "state-of-the-art" is designed to introduce the present state of development of non-agricultural soil erosion and sediment control. The approach employed to provide structure to the discussion involves consideration of four separate factors of the problem: administration, legal, technical, and economic aspects. No attempt is made to address any one factor comprehensively or in detail. Rather, the objective is to provide a preliminary description of significant developments, including a limited number of illustrative examples.

The action guidebook appearing in the third section of the report is largely non-technical in nature, prepared from an overall policy-making point of view and designed around the concept that it would be a guide for realistic erosion and sediment control programs at the local and community level. It discusses state and local enabling legislation requirements; the role of the federal government; the role of state governments and regional agencies; and the elements of a viable erosion and sediment control program, including: planning, organization, staffing, financing, financial and technical assistance, operations, and public acceptance and support.

It was produced after a careful analysis of material existing in the subject field, and extensive use of interviews and contacts with leaders in this field, employed by federal, state and local government, and by private organizations. Fifteen field examinations were conducted to better understand problem areas and avenues of success.

The guidebook was prepared so as to allow review of its development by participants of the National Conference on Sediment Control held during September 1969. It was subsequently revised in conformance with recommendations generated by the participants.

Establishing control over urban and suburban sedimentation problems was found to require the involvement of several local groups and agencies. Effective sedimentation control programs, therefore, must be able to delineate and accommodate this diversity of involvement. The theoretical approach employed in the guidebook to solve the problem involved two basic concepts: definition of the geographical scope of the problem in terms of drainage or subdrainage areas, and secondly, the task force management concept.

The third and final section is a listing of some of the needs for research in urban and suburban sedimentation control that were detected during the investigations connected with preparation of this report.

SECTION II

STATE OF THE ART

Administration of Sedimentation Control

There is generally a lack of agreement with regard to the extent of the sedimentation problem in the United States. This disparity is reflected in the literature on sedimentation which provides little consistency in citation of figures and facts related to such items as sediment yields, erosion factors, sediment transport, sediment damage, and the effect of sediment on water quality.

In large part, the lack of adequate sedimentation estimates is due to the inherent technical difficulties associated with measuring erosion losses and sediment yields, and in analyzing the effect that sediment has on water quality. In addition, the lack of knowledge about sedimentation may be traced to the fact that the field of sedimentation has not received as much attention as have the more classic pollutants, such as BOD and sewage solids. The lack of comprehensive inquiry into the sedimentation field has made it necessary to estimate erosion losses and sediment yields on the basis of extrapolations made from investigations of more limited scope.

Despite the lack of comprehensive research, however, the research that is being conducted indicates that sedimentation problems arising from the country's massive suburban and urban growth are extensive. Sediment from the nation's highway construction and maintenance amounts to an estimated 56 million tons each year. Stream channel erosion contributes about 500 million tons of sediment to streams annually. Approximately 850,000 acre-feet of sediment are deposited in the nation's reservoirs each year.

Overall, it is estimated that the total amount of sediment moving into the nation's rivers, lakes, estuaries, reservoirs, streams, and other water bodies is four billion cubic yards annually.

Specific sedimentation studies conducted in suburbanizing areas indicate that sediment yields from these areas may be as much as 500 times as great as is normal in agricultural areas. For example, a study conducted in Kensington, Maryland, a growing Washington, D. C. suburb, states that given certain conditions, "It is reasonable to assume that the streams draining the area around metropolitan Washington will transport 20 million tons of sediment to the Potomac River in the next 20 years."[1] This report notes that it is plausible to expect 10 tons of sediment to be created for each person added to the city's population. Other studies similarly suggest that under certain common hydrologic, geologic and soils conditions, very high sediment yields can be expected during the suburbanization process.

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[1] H. P. Guy, "Residential Construction and Sedimentation at Kensington, Maryland." Reprint from proceedings of the Federal Inter-Agency Sedimentation Conference, 1963. Miscellaneous Publication No. 970, Agriculture Research Service, issued June 1965. (U.S. Department of Interior Geological Survey) p. 37.

Some knowledge has been acquired with regard to the many effects that sediment has on water quality. In some instances, sediment is known to interfere with life cycles of aquatic animals and organisms. For example, sediment sometimes covers the spawning beds of shellfish, which inhibits their survival. In addition, sediment particles have been reported to carry pesticides and other toxic materials into waterbodies where they affect aquatic life.

By clogging sewer lines and storm drainage systems, sediment interferes with waste water treatment operations. Sediment, by causing stagnant streams and waterbodies, and by interfering with water organisms, is also reported to reduce the capacity of water to purify itself.

Soil erosion is not the only source of sediment. Recent research into urban drainage problems finds that significant sediment yields result from storm water runoff in developed urban areas. In one study, "street litter" was found to be a significant water pollution source in the test cases cited. The dirt and dust component of street litter (other components consist of such refuse as grass clippings, twigs, discarded cans, leaves, etc.) was found to vary from 0.4 to 5.2 pounds per day per 100 feet of curb.[2] This study recommended, among other suggestions, that improved street cleaning techniques be developed and that more effective regulations and ordinances be established and enforced with regard to street cleanliness. In addition, this study suggests that the full dimensions of the water pollution threat posed by urban storm water runoff have not been adequately investigated.

Research into the many problems associated with sedimentation has not been comprehensive. The findings of the research conducted thus far, however, are important because they suggest that sediment is seriously affecting both the quality of water, and the quantity of water supplies. These findings also indicate that because of the massive and prolonged process of suburban development occurring in this country, sedimentation problems are likely to continue, both during and after construction, unless effective control procedures are developed and implemented.

The administrative aspects of urban and suburban sedimentation control have not, in general, been systematically explored or defined by either federal, state or local governments. In part, the lack of administrative experience in the field of urban and suburban sedimentation may be attributed to the fact that soil erosion and sediment have traditionally been regarded as problems associated with rural activities in general and agricultural activities in particular. The historical emphasis on the rural nature of sedimentation is reflected in the elaborate and decentralized administrative structure that has developed within the United States Department of Agriculture to assist farmers in soil erosion control (as well as in other agriculturally related problems). The Soil Conservation Service provides individual technical assistance to farmers through soil conservation districts (sometimes called soil and water conservation districts or conservation districts) which have been established in nearly every county in the nation.

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[2] U.S. Department of Interior, Federal Water Pollution Control Administration, Water Pollution Aspects of Urban Runoff, by the American Public Works Association. Water Pollution Control Research Series WP-20-11 (January, 1969), p. 2.

No administrative apparatus exists to serve areas that are undergoing suburban and urban development, although many such areas, having recently been converted from rural uses, continue to receive assistance from conservation districts.

The role of federal agencies with regard to the administrative aspects of sedimentation control takes the form of establishing legal standards which regulate water quality. The Federal Water Quality Administration, U.S. Department of the Interior, for example, declares turbidity to be a pollutant where it interferes with the beneficial uses of water. In effect, this has made it legally possible to include turbidity within the criteria for establishing state water quality standards. However, the impact that such legislation may have on local communities has not been thoroughly investigated.

At the local level, very little experience has been accumulated with urban and suburban sedimentation control programs. The most notable of the urban and suburban sedimentation control efforts which have been established as discreet control programs have not employed administrative approaches typically used for controlling soil erosion in rural areas where land ownership is more permanent, land usage more stable, and where competitive interests are less intense than in areas undergoing development. Administration of sedimentation control programs in urban areas is complex because:

> land ownership is frequently temporary or in transition, making it difficult to place legal accountability on offending parties;
>
> such control, to be effective, must be included within ongoing political and administrative processes such as planning and zoning, and in local laws, all of which are subject to a diversity of pressures;
>
> such control must be premised on the "public interest", which is often difficult to define;

such control, to be effective, needs to be based on physical drainage characteristics which seldom coincide with political boundaries;

the role and jurisdictions of many local agencies, such as sanitation agencies, departments of public works, planning commissions, conservation districts, and others in connection with sedimentation control are not well defined in most communities. Most significantly, these agencies in most localities have little experience in working together, within a uniform administrative framework, to establish control over sedimentation problems;

the activities associated with the causes of urban and suburban sedimentation, such as homebuilding, highway construction, and construction of public facilities and utilities, are more complex than sedimentation from agricultural activites. The logistical complexities of urban and suburban construction and development activities requires sophisticated administrative approaches which accommodate the reasonable exigencies of development and construction patterns, yet which lead to effective sedimentation control.

The Task Force Approach. Several localities have established relatively effective sedimentation control programs in which a task force administrative format has been employed. Under this format, representatives of various agencies and groups meet periodically to develop an organized program for sedimentation control. The role and authority of each agency and group in the control program is set forth and each agency accepts responsibility for a designated aspect of control.

Montgomery County, Maryland instituted one of the first sedimentation control programs using the task force approach. Involved in the task force were such groups and agencies as the department of public works, the soil conservation district, the Washington Suburban Sanitary Commission, the Washington Metropolitan Council of Governments, the U.S. Geological Survey, the Suburban Maryland Homebuilders Association, the Interstate Commission on the Potomac River Basin, the Maryland National Capitol Park and Planning Commission, and the Montgomery-Prince George's Engineers Society. This task force developed a control program in which various local agencies were assigned specific responsibilities with regard to sedimentation control.

It should be noted that the task force approach is an administrative approach which is useful only when it is supported by appropriate local legislation, or administrative rulings and codes. Legislation, or administrative rulings and codes are needed to assign specific sedimentation control responsibilities to local agencies.

Although the task force approach has proven useful in several notable instances, such as in Montgomery County, it has not been widely used throughout the country; nor has its effectiveness been demonstrated in areas having sedimentation problems which differ significantly from those in Montgomery County. The need for multi-agency involvement, and a spirit of cooperation, would appear to be essential components of the task force approach.

Planning. The relationship between sedimentation control efforts and local planning processes is not well defined. Most significantly, it is not well understood by local leaders how sedimentation control principles, measures and provisions are related to various types and levels of local planning.

At the present time, very little information has been compiled with regard to the sedimentation planning activities that are being carried out by local and state agencies. Specifically, there is a lack of information concerning the means by which various local government agencies, such as departments of public works, planning agencies, sanitary agencies, and others can coordinate their sedimentation control planning activities.

Little information is available with regard to sedimentation control planning on an areawide basis. In particular, little attention has been given to refining the role that areawide planning agencies, such as councils of governments, economic development districts, and similar multi-jurisdictional bodies can assume in sedimentation control efforts. Inasmuch as the prevailing consensus in current conservation literature endorses areawide (drainage area) approaches to soil and water conservation, the desirability of developing appropriate responsibilities for areawide agencies should be considered.

In many areas of the country, the fragmented condition of local government responsibilities makes planning for storm drainage systems on an areawide (drainage area) basis difficult. In many counties, for example, it is difficult to develop and implement comprehensive drainage policies and standards because the jurisdiction of the county does not extend into incorporated areas of the county. The existence of numerous special purpose districts also hampers an areawide planning approach.

Terms, Concepts and Information Distribution. One of the fundamental problems in establishing control over sedimentation problems is the confusion which exists in the terminology employed in the sedimentation field. Whereas the technical terminology associated with sedimentation can be and is employed with relative consistency and rigor, the terms associated with the administrative aspects of sedimentation problems and programs are frequently ambiguous and are not used with consistency in reference to the concepts to which they allude.

Ambiguity of terms, and of concepts, has led to some confusion with regard to what specific steps should be taken to organize and implement sedimentation control programs at the local level. An example of terms and concepts which are not adequately defined is the distinction that may be made between sedimentation control "principles", sedimentation control "measures", and sedimentation control "provisions". These terms are often used in local ordinances, codes, and administrative rulings to set forth the administrative and operational requirements of local agencies in sedimentation control programs. The many alternative ways in which these terms may be interpreted has a bearing on the efficiency with which the control program operates, and may interfere with effective enforcement.

One of the first efforts to compile a glossary of terms for comprehensive resource conservation has been made by the Soil Conservation Society of America. This glossary, an updated and expanded version of an earlier report, is titled "Resource Conservation Glossary". It is published by the Soil Conservation Society of America, (1970), and is intended for use by professionals, laymen, and students.

One of the difficulties associated with establishing local sedimentation control programs is the lack of information at the local level of government. No comprehensive information dissemination program exists which is capable of distributing needed information to local jurisdictions which have sedimentation problems. Consequently, local leaders are often unaware of what can be done to establish sedimentation control. Of particular significance is the lack of information with regard to federal and state water quality standards, and how these standards relate to local sedimentation control efforts. Also, it is frequently unclear as to what federal and state financial and technical assistance is available to local sedimentation control efforts.

Legal Aspects of Sedimentation Control

Causes of water pollution fall into two broad categories--untreated or inadequately treated wastes from easily identifiable sources such as municipal and industrial wastes; and wastes from diffuse or nonpoint sources such as sediment and street debris washed into water courses from a heavy rain.

Current federal action in the water pollution control field is directed at the more obvious and more manageable forms of pollution, e.g., control of pollution from cities with inadequate waste treatment facilities or none at all, and major industrial plants which either have unsatisfactory treatment or no treatment at all.

This emphasis is reflected in existing federal anti-pollution legislation. In connection with combating sediment as a pollutant, federal agencies must now rely on the same tools as are available in the struggle against other forms of pollution. The Federal Water Pollution Act of 1956, the Water Quality Act of 1965, the Clean Water Restoration Act of 1966, and the Water Quality Improvement Act of 1970 provide the major muscle in this effort.

To date, the most notable federal administrative action to effect sediment control is Executive Order 11507 through authority of the Water Pollution Control Act. The order requires application of control measures on all federally aided development and construction operations where there is a significant potential for the reduction of pollution due to sediment. This should be most significant in connection with sediment problems resulting from urban and suburban highway construction.

In compliance with the Water Quality Act, water quality standards, along with plans for implementing and enforcing them, have been established by all 50 states and are fully or partially approved by the Secretary of the Interior. Thus, they are federal as well as state standards. A characteristic of the standards crucial to sediment pollution control is their flexibility. Flexibility was allowed so that the standards could be changed to conform to changing conditions, and to the application of new technologies as they are introducted. However, flexibility may be the cause of the current neglect in sediment pollution control efforts. Not one state, for example, has set forth specific criteria on suspended solids in the water quality standards they have submitted. This is a disturbing situation when it is considered that sediment has become a major pollutant of our waters.

Among the U.S. Department of the Interior's activities for controlling sediment pollution is a continuing effort urging states to give special attention to land erosion in their compliance programs. Many of the states are working with the Soil Conservation Service to develop sound land management practices to keep sediment out of their waterways. This, however, is not enough. A better approach is to enact laws to regulate and prevent erosion from non-agricultural development and construction activities. This is the approach taken by Maryland. A recently enacted law (Chapter 245, Maryland Laws of 1970) makes statewide sedimentation control mandatory by requiring state and local government agencies to implement sedimentation control measures during their development and construction activities; and by authorizing county governments to enact regulations to control private development and construction activities. Major provisions from the Maryland law follow:

> Chapter 245
>
> AN ACT providing for a sediment control program applicable statewide requiring review AND APPROVAL by the appropriate soil conservation district and IN SOME CASES BY THE Department cf Natural Resources of PLANS FOR certain activities disturbing land.
>
> SEC. 3. And be it further enacted, That new Sections 105 through 110 inclusive, be and they are hereby added to Article 96A of the Annotated Code of Maryland (1957 Edition.

1961 Replacement Volume and 1969 Cumulative Supplement), title "Water Resources," to follow immediately after Section 104 thereof and to be under the new subtitle "Sediment Control" and to read as follows:

Sediment Control

105

The General Assembly of the State of Maryland hereby determines and finds that the lands and waters comprising the watersheds of the State are great natural assets and resources; that as a result of erosion and sediment deposition on lands and in waters within the watersheds of the State, said waters are being polluted and despoiled to such a degree that fish, marine life, and recreational use of the waters are being adversely affected. IN ORDER TO PROTECT THE NATURAL RESOURCES OF THE STATE, THE SECRETARY OF NATURAL RESOURCES IS DIRECTED TO ADOPT CRITERIA AND PROCEDURES TO BE USED BY THE COUNTIES AND THE LOCAL SOIL CONSERVATION DISTRICTS TO IMPLEMENT SOIL AND SHORE EROSION CONTROL PROGRAMS. SUCH PROCEDURES MAY PROVIDE FOR THE REVIEW AND APPROVAL OF MAJOR GRADING, SEDIMENT AND EROSION CONTROL PLANS BY THE DEPARTMENT OF NATURAL RESOURCES.

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(A) Before land is cleared, graded, transported, or otherwise disturbed for purposes including, but not limited to the construction of buildings, the mining of minerals, the development of golf courses, and the construction of roads and streets by any private person, partnership, corporation, MUNICIPAL CORPORATION, COUNTY OR STATE AGENCY within the State of Maryland, the proposed earth change shall first be SUBMITTED TO AND approved by the appropriate soil conservation district. . . . . LAND clearing, soil movement and construction shall be CARRIED OUT in accordance with the written recommendations of the said soil conservation districts regarding the control of erosion and siltation and the elimination of pollution.

(C) THE DEPARTMENT OF NATURAL RESOURCES SHALL ASSIST THE SOIL CONSERVATION DISTRICTS IN THE PREPARATION OF A UNIFIED SEDIMENT CONTROL PROGRAM AND IN THE IMPLEMENTATION OF SAID PROGRAM PURSUANT TO THIS SUBTITLE.

(D) NOTWITHSTANDING THE PROVISIONS OF THIS SECTION, THE DEPARTMENT OF NATURAL RESOURCES SHALL REVIEW AND APPROVE ALL LAND CLEARING, SOIL MOVEMENT AND CONSTRUCTION ACTIVITY UNDERTAKEN BY ANY AGENCY OF THE STATE GOVERNMENT.

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The provisions of this subtitle shall not apply to AGRICULTURAL LAND MANAGEMENT PRACTICES, THE CONSTRUCTION OF AGRICULTURAL STRUCTURES OR TO THE CONSTRUCTION OF SINGLE-FAMILY RESIDENCES AND/OR THEIR ACCESSORY BUILDINGS ON LOTS OF TWO ACRES OR MORE. Regardless of planning, zoning or subdivision controls, no permits shall be issued by any county OR MUNICIPALITY for grading or for the construction of any building, other than those MATTERS exempted above, unless such grading or construction is in accordance with plans approved as provided in this subtitle.

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. . . . (A) THE COUNTIES AND MUNICIPALITIES SHALL HAVE THE POWER AND AUTHORITY TO ISSUE GRADING AND BUILDING PERMITS AS OTHERWISE PROVIDED BY LAW. NO GRADING OR BUILDING PERMIT SHALL BE ISSUED UNTIL THE DEVELOPER SUBMITS A GRADING AND SEDIMENT CONTROL PLAN DESIGNED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF MARYLAND, APPROVED BY THE APPROPRIATE SOIL CONSERVATION DISTRICT, AND THE DEVELOPER CERTIFIES THAT ALL LAND CLEARING, CONSTRUCTION AND DEVELOPMENT WILL BE DONE PURSUANT TO THE SAID PLAN. CRITERIA FOR SEDIMENT CONTROL AND FOR REFERRAL OF AN APPLICANT TO THE APPROPRIATE SOIL CONSERVATION DISTRICT SHALL BE ACCEPTABLE TO THE SOIL CONSERVATION DISTRICT AND THE DEPARTMENT OF NATURAL RESOURCES. THE COUNTY AGENCY RESPONSIBLE FOR ON-SITE INSPECTION AND ENFORCEMENT OF THE PROVISIONS OF THIS SUBHEADING SHALL MAKE A FINAL INSPECTION AND FORWARD ITS REPORT TO THE APPROPRIATE SOIL CONSERVATION DISTRICT. NOTICE OF VIOLATION OF THE PROVISIONS OF THIS SUBTITLE SHALL BE FILED WITH THE DEPARTMENT OF NATURAL RESOURCES, AS WELL AS WITH THE APPROPRIATE COUNTY AGENCY.

(B) EACH COUNTY SHALL ADOPT GRADING AND BUILDING ORDINANCES, OR PORTIONS THEREOF, WHICH ARE NECESSARY TO CARRY OUT THE PROVISIONS OF THIS SUBTITLE. THE DEPARTMENT OF NATURAL RESOURCES AND THE APPROPRIATE SOIL CONSERVATION DISTRICT SHALL ASSIST THE SEVERAL COUNTIES IN THE DEVELOPMENT OF SUCH ORDINANCES OR NECESSARY PORTIONS THEREOF. THE PROVISIONS OF THIS SUBSECTION SHALL BE CARRIED OUT PRIOR TO MARCH 1, 1971. PRIOR TO MARCH 1, 1971, ESTABLISHED ORDINANCES AND PROCEDURES SHALL BE USED BY THE COUNTIES TO CARRY OUT THE PROVISIONS OF THIS SUBTITLE.

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Any violation of this subheading shall be deemed a misdemeanor, and the person, partnership, or corporation who is found guilty of such violation shall be subject to a fine not exceeding five thousand dollars ($5,000.00) or one year's imprisonment for each and every violation. Any agency whose approval is required under this subheading or any person in interest may seek an injunction against any person, partnership, or corporation, whether public or private, violating or threatening violation of any provisions of this subheading.

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. . . . . FOR THE PURPOSES OF THIS SUBHEADING, THE BUREAU OF PUBLIC WORKS OR SIMILAR MUNICIPAL AGENCY IS EMPOWERED AND DIRECTED TO ACT IN THE PLACE OF THE APPROPRIATE SOIL CONSERVATION DISTRICT IN MUNICIPALITIES WHICH ARE NOT WITHIN A SOIL CONSERVATION DISTRICT.

SEC. 8. And be it further enacted, That all laws or parts of laws, public general or public local, inconsistent with the provisions of this Act, are hereby repealed to the extent of any such inconsistency.

An example of a Maryland county ordinance which carries out the above provisions of Chapter 245, Maryland Laws of 1970 follows:

SEDIMENT CONTROL ORDINANCE-Montgomery County, Maryland
(Amendment to the Subdivision Ordinance, Chapter 104, as Codified in 1965 Montgomery County Code)

A new subsection is added to Sec. 104-24 Preliminary Subdivision Plan-Approval Procedure, to be known as Sec. 104-24(i), as follows:

Sec. 104-24

(i) Sediment Control. The approval of all preliminary plans will include provisions for erosion and sediment control, in accordance with the Montgomery County Sediment Control Program, adopted by the County Council June 29, 1965.

1. The board in its consideration of each preliminary plan shall condition its approval upon the execution of erosion and sediment control measures, as recommended by the Montgomery Soil Conservation District, by the developer during clearing and grading operations.
2. One copy of each approved preliminary plan will be referred to the Montgomery Soil Conservation District for review and recommendation as to adequate erosion and sediment control measures to prevent

damage to other properties.
3. The installation and maintenance of the recommended erosion and sediment control measures shall be accomplised in accordance with the procedures for Public Works Agreement as specified in Sec. 104-26(g), and in accordance with standards and specifications on file with the Montgomery Soil Conservation District.
4. Permission for clearing and grading prior to recording of plats may be obtained under temporary easements or other conditions satisfactory to the Department of Public Works and the Montgomery Soil Conservation District.
5. In the event developer proceeds to clear and grade prior to recording of plats, without satisfying conditions specified under Sec. 4, the Board may revoke the approval of the preliminary plan.

Amend Article 1, Section 23-2, General Requirements (of subdivision plans) by the addition of a new paragraph to be known as 23-2(1) to read as follows:

(1) Erosion and Sediment Control Measures. Adequate control of erosion and sedimentation of both a temporary and permanent nature shall be provided during all phases of clearing, grading and construction as approved by the Director.

Amend Section 23-8, Preliminary Plats - Preparation by the addition of a new paragraph to be known as 23-8(g) to read as follows:

(g) Preliminary plats shall include: a) statement that Erosion and Sediment control methods shall be provided prior to any clearing, grading or construction.

Amend Article 2 of Chapter 23 by the addition of a new paragraph to Section 23-12. Final Plats - Approval to be known as 23-12(c) to read as follows (plats shall be approved only if):

(c) Plans and specifications for the control of erosion and sedimentation, if such controls are deemed necessary, have been submitted and approved by the Director of Public Works or his agent. This approval shall be concurrent with the approval of the aforesaid plans and specifications, and become a part thereof.

Local ordinances aimed at controlling erosion and sediment presently lack specific criteria on permissible levels of suspended solids and sediment loads. One reason for this appears to be the current need for developing inspection techniques through which turbidity and sediment can be reliably traced to their point-of-origin sources. This is difficult because most silt and sediment problems stem from several diffuse or non-point sources.

Rather than set water quality standards, local ordinances are designed to insure the application of needed erosion control measures. In all cases studied by NACORF, erosion control provisions were incorporated into existing regulations (e.g., building codes, grading ordinances, subdivision regulations, etc.) rather than being written as a separate, self-contained document. A significant finding is that of those local governments found to have adopted legal provisions, less than half cover temporary as well as permanent erosion control. Thus, a most critical period - the grading and construction stage - is in many areas of the county without regulations.

In addition to inadequate legal provisions, many local governments applying or in need of erosion and sediment control measures suffer for lack of areawide jurisdiction. For the purposes of this report, areawide may be defined as a physical area, the boundaries of which are determined by natural water drainage areas. This definition implies no specific geographic size except that which is determined by the drainage area. Thus, an areawide unit may or may not cross political jurisdictional boundaries.

Where areawide control is needed and at the same time involves several political jurisdictions, intergovernmental cooperation for a coordinated and comprehensive control program is necessary. Often, however, enabling legislation is needed to enter into intergovernmental agreements by state political subdivisions pursuing such programs. Legal authority for intra-county, as well as for intercounty, agreements, needs consideration by state and local officials. Examples of parties to intra-county agreements include the county, incorporated areas of the county and special districts.

Improvements are needed in federal, state and local sedimentation legislation which will provide protection against activities which constitute temporary infraction of control provisions. (See Maryland House Bill 509, page G22, Community Action Guidebook for Soil Erosion and Sediment Control.) This is of particular importance in sedimentation control because much of the sediment pollution damage occurs within short time frames, such as during flash storms, or during rainy seasons.

Technical Aspects of Sedimentation Control

Much remains outside the current boundaries of research information and cost analysis with regard to sedimentation. Silting and discoloring of streams by sediments is a major problem but sedimentation also produces other pollution by acting as carrying agent for such pollutants as pesticides, nutrients, and bacteria, as well as decomposable organics and natural toxicants. Solutions to these problems is a matter of involving the individual land owner, the appropriate social institutions, and technology, in an effort to provide the land use practices needed to fix land in place. The U.S. Department of Agriculture currently spends about $200 million a year on programs designed for soil conservation; about 20 percent of these funds is spent on urban sedimentation problems. USDA officials feel much research remains to be done in the way of quantifying the problem and its remedial costs.

An example of current research being conducted to quantify the scope of non-agricultural sediment problems is the sedimentation and hydrology study of the Rock Creek and Anacostia river basins in Maryland and the District of Columbia. The main purpose of the study is to determine the differences in stream sediment loads resulting from use of various erosion reduction techniques on land undergoing urban development. The project was initiated in July of 1965 and is scheduled to terminate June 1975. The area being studied is within the rapidly developing upper reaches of the Anacostia River and Rock Creek basins which are tributary to the Potomac River in Washington, D. C.

The approach being used to carry out the study involves comparing sediment yields among basins subjected to various erosion control measures such as provision of sediment trapping reservoirs or seeding of stripped land. However, measurements will be made for some basins upon which no sediment controls have been imposed. The effects of different housing densities on sediment production also is being studied. Other objectives of the study include:

> Evaluation of amounts of sediment released into streams before, during and after active urban development in relation to aspects of upstream land use, such as size of areas being developed and quantity of land stripped of vegetation. Included is an account of the effect of variations in associated precipitation distribution on the sediment loads from the different areas under observation.
>
> Analysis of data to ascertain if there are significant changes in stream-flow characteristics such as peak discharge and sustained low flow magnitudes.

In addition to sediment yields from urban and suburban development, is equally severe sediment pollution resulting from highway construction. An example of studies designed to quantify the magnitude of this problem is the current analysis of highway construction activities in five water-sheds in Cumberland County, Pennsylvania. A description of this study, which began in the fall of 1969 and is to last for five years, appeared in the Pennsylvania Soil and Water Conservation Commission's August 1969 publication of Teamwork:

> The streams, four of which lie in the construction area of a portion of Interstate 81, will be monitored electronically, visually, and by laboratory analysis in a project to study erosion control methods that will be tested with the construction of the super highway.
>
> The project will be conducted jointly by the State Soil and Water Conservation Commission, Water Resources Division of the U.S. Geological Survey and the Pennsylvania Department of Highways. The Soil Conservation Service is serving in an advisory capacity on this project.
>
> Computers and sampling equipment to measure water flow, volume, stream velocity, and suspended sediment in the water will be available in each testing area. Regular checks will be made to determine stream conditions prior to construction of Route 81. The sampling will continue for a full year after construction is completed in late 1971.
>
> The stream not located in the immediate construction area will be used as a "control" and the monitoring results will be compared with those for streams in the construction area.
>
> Three erosion-control measures have been proposed for the study. They are:
>
> 1) Mulching and seeding during the first planting season that the highway slope is completed. This is considered a standard highway practice but often is applied only after considerable earth-moving has occurred.
>
> 2) Mulching as soon as possible after earth-moving begins and standard seeding during the first planting season that the slope is completed.
>
> 3) The use of structural features, such as temporary desilting basins or diversion terraces, or an advanced erosion control measure, such as an erosion inhibiting chemical applied to exposed slopes. These measures would be combined with the establishment of vegetative cover . . . As a result of the survey, a complete report on the ability of each measure to prevent sediment from entering a stream is anticipated.

The research experience gained from studies of runoff and sediment characteristics of urban and highway construction indicates a need for developing new measurement techniques for the non-agricultural setting. Methods applicable to rural areas are not universally applicable to the less constant variables in urban areas. Urban construction, for example, may be started and completed in about two years. This time span for collecting information is much different from agricultural areas where characteristically stable land use allows ten years or more to collect representative data. Moreover, the relatively small areas under study in urban construction make the amount of time during runoff less for data collecting than that available for large rural areas. Thus, an automatic and semi-automatic measuring system for urban areas needs to be developed.

Another environmental difference between agricultural and urban areas is that erosion and sediment transport during urban construction usually occurs on exposed non-vegetated subsoils. This adverse condition is further compounded by very steep and compacted slopes. Agricultural areas, on the other hand, involve topsoils, natural slopes, loose tillage and extensive vegetative cover. Thus, research methods are needed that differentiate overland runoff that carries sediment from that of subsurface runoff when study involves drainage basins incorporating agricultural as well as developing urban areas.

Factors Affecting Sediment Yields. Probably the most important key to the rate and magnitude of non-agricultural development and construction activity is the rate of population growth. One method that is currently employed to measure the extent of future development in a given geographical area is to divide current population density per square mile into projected population figures.

Once projected population growth is established, the present and future development and construction that this growth will affect can be expected to take place according to the land's drainage pattern. Although it affects the direction of transportation routes, its major impact is on the design of underground sewer systems. The drainage pattern also influences land use. Flood plains, for example, may be zoned for recreational use only in order to maintain natural surface runoff velocities and to prevent harmful inundation.

The effect of growth in terms of sediment pollution may be determined by its relationship to the course of natural streams. Where advancing development is taking place along the narrow dimension of a stream the sediment load can be expected to remain constant. On the other hand, where growth is encroaching on the major axis or width of a stream basin, sediment pollution can be expected to heavily increase as the construction ring passes over the basin.

Soils of an area are important because their particle size, percolation and infiltration rates affect the extent of raindrop splash erosion, sheet erosion, amount of surface runoff, and fill and gully erosion.

The soil's natural fertility determines the rate which vegetation can be restored once stripped. In the Southwest, restoration may take ten years or more.

Surface runoff is the key variable in determining the amount of sediment movement. Where soils are impervious or saturated, continued precipitation will become the transporting agent of sediment.

Sediment movement from construction sites will depend on the season of the year because precipitation intensity fluctuates seasonally and because of seasonal differences in construction activity. A determination of seasonal runoff differences is, therefore, useful in making rational planning decisions for construction activity. The method used in making such a determination in the Potomac River Basin involved subtracting the estimated base or ground-water flow at several streams in the area from their total flow for the years 1949-60 to provide a monthly record of the surface runoff. (In selecting locations within an area for precipitation measurement, consideration should be given to differences in soil percolation and infiltration rates.)

The seasonal disparities evident in precipitation intensity and in construction activity can be expected to indicate more precipitation and construction during warmer months than cold. Studies by USGS show that at several locations of storm sediment discharges in Atlantic Coast streams was twice as great for warm months than for cold, the seasonal differences can be expected to be even more severe at graded construction sites where the soil is more compacted than the common soils found in rural drainage basins.

Approaches to Sediment Control. The "areawide approach" to control runoff, erosion and sediment transport involves studies of all land and drainageways from which water and sediment can reach and impair downstream facilities. It is premised on control or treatment of entire drainage or subdrainage areas. This procedure allows the planner to develop a comprehensive system of control measures for a drainage area as a self contained unit without adverse effects to intermediate and downstream property. The areawide approach is in contrast to the segmented approach which often limits corrective action and control to a random application of uncorrelated practices.

The Interstate Commission on the Potomac River Basin outlined the factors to be considered when following the "areawide" concept in designing sedimentation control programs:

1) The drainage pattern with respect to steepness, length and orientation of slopes and the density and capacity of channel systems.
2) The geology, soils, and the kind of land use.
3) The rainfall and run-off data.
4) The sediment transportation and deposition.

5) Alternate remedial measures including cost studies for proposed works of improvement.

It is general practice under the drainage-area (areawide) approach to utilize data in these categories to evaluate the following conditions:

1) The existing condition of the drainage area, or the base to which a proposed project is applied. In the case of forthcoming urbanization of a rural area, such evaluation must anticipate the "untreated" urban condition.
2) With planned vegetative measures, minor structural measures, and projected land use adjustments superimposed on the existing condition . . .
3) With planned vegetative measures, minor structural measures and projected land use adjustments on which major structural measures are imposed if needed. (Condition 2, above, plus major structural measures.)

The three drainage area conditions are always evaluated in the order given above. This logical order insures that the measures having the first effect on run off be evaluated first and those having the last effect be evaluated last. In some cases, the second or third conditions may be further subdivided in order to evaluate a particular group of measures. Here again, measures having the first effect on run off and sediment transport are evaluated first.

Final project formulation, including the selection of remedial measures, is based on the results of the above analysis evaluation through comparison of the costs of proposed segments of remedial programs to the benefits to be derived from the reduction of floodwater and sediment damage. An economic evaluation of this nature is vital to the acceptance of remedial programs for control of sediment and floodwater in a drainage area.

The segmented approach seldom provides the level of control desirable because it normally treats the obvious points of damage without addressing all the basic and underlying causes of the problem. However, the many vegetative and minor structural measures of the segmented approach can be effectively employed to reduce sediment from construction sites where public opinion is not favorable for the more comprehensive areawide approach. A beneficial application of the segmented approach can especially be made to urban and suburban housing developments. Streets can be located so as to minimize cut and fill banks and the exposure of subsoil. Residential lots can be left in their natural contour without unnecessary disturbance of existing vegetation or design to provid vegetated bench terraces rather than the usual practice of developing these sites on terrain which includes extensive areas of uniform and highly erodible slopes. Grading can be done incrementally as construction progresses rather than all at once leaving large areas of exposed soils for periods of up to years in many cases. Control of the size of construction sites and the sequence of letting building permits and contracts will limit the extent and time of exposed soil.

Control Measures and Practices. Significant progress has been made in applying conventional erosion and sediment control measures and practices to the urban and suburban setting. A brief description of some of these follows:

1) Non-critical area vegetation - Non-critical areas are those of good soils on moderate slopes. The establishment and maintenance of good vegetative cover in these areas is relatively simple as compared to "critical areas." Non-critical areas can usually be stabilized by utilizing the standard plants and establishment techniques recommended by local agencies or landscaping services. Soil tests should be made as a basis for adding the plant food necessary for plant establishment and maintenance.

2) Critical area vegetation stabilization - Critical areas are those in which cutting, filling, and grading soils with heavy equipment often result in the exposure of soils and subsoils. Certain conditions resulting from such exposure, such as acidity, low fertility, compaction, or dryness or wetness which are unfavorable to plant growth, often prevail. Excessively long slopes and steep grades are often encountered or created. Water disposal structures are normally subjected to hydraulic forces requiring both special establishment techniques and grasses which have high resistance to scouring. However, plants and techniques are available to provide both temporary and permanent protective cover on these difficult sites. These are:

   Temporary Measures - These involve seeding with fast growing annuals such as rye, ryegrass, sudan grass, or other locally adopted vegetation which provide quick protection yet can be worked into the soil when the site is prepared for final seeding of a permanent species. An alternative method is the application of mulch for immediate protection. At the proper time, mulch can be removed, worked into the soil, or successfully overseeded with permanent grass and legume species. Materials that may be used as a mulch include straw, fiberglass, wood chips, or fiber, and mechanically sprayed asphalt wood fiber slurry, and plastics or other synthetics.

   Permanent Vegetation - For both sodding and seeding, there is a fairly wide choice of grasses, legumes, and other plants for use on critical areas. The final choice of species should be determined by weighing such factors as adaptability, use, aesthetic requirements, a degree of maintenance that can be expected and other special considerations.

3) Diversions - A diversion consists of a channel or ditch and a ridge constructed across a sloping land surface on the contour, or with predetermined grades to intercept and divert surface runoff before it gains sufficient volume and velocity to create harmful erosion. The water is collected and conveyed laterally along the diversion at slow velocity and discharged into a protected area or outlet channel.

4) Bench terrace - Bench terraces are relatively flat surfaces constructed on sloping land or embankments to planned dimensions and grades. Bench terraces are applied along the contour with the length and width controlled by the natural terrain and the required erosion limitations. Contour benches may be installed across a slope and may be designed for widths which will permit construction of a row or tier of housing units.

5) Outlet channels - This measure consists of the construction of designed channels for the disposal of storm runoff from diversions, bench terraces and other structures. The design is based on the runoff from predicted storm events and includes the vegetative or structural measures required to protect the channel from scouring and erosion.

6) Water stabilization structures - Waterway erosion control methods include structural devices to dissipate the energy of flowing water by holding the waterway slopes and velocities within non-scouring limits. Drop structures, and concrete or other lining could be utilized in an open waterway to control water velocity.

7) Bank erosion structures - Methods commonly used to control bank erosion in main stream channels include riprap, rock cribs, groins, jetties, fencing, piling, etc. The purpose of these measures in to install a barrier that will withstand the erosive forces exerted by flowing water or to create a bank roughness that will reduce the erosive power by dissipating energy of the water as it moves along the bank line.

8) Stream channel construction - It is often impractical to attempt control of an existing meandering channel. In

this case, channel straightening, realignment, or the construction of a new channel to designed cross-section and grade is necessary. In doing this, however, the danger exists of creating a new erosion cycle. The design must include considerations regarding the stability of the bed and banks of the proposed channel under the predicted runoff conditions.

9) Sediment basins - The construction of an earth fill type dam downstream from a development area serves to regulate runoff and trap sediment. The sediment can be removed mechanically as the storage space behind the dam becomes filled, or sufficient space may be built into the structure to provide storage for its useful life. The whole structure can be removed after stability is reached in the development area or it can be retained and maintained to enhance the area.

Major Structural Measures. As a part of areawide (or drainage-wide) water management, erosion and sediment control may call for major capital improvements that also serve other objectives of water management, e.g., flood control, recreation, and water supply and storage. Application of these measures will depend on:

1) the multiple of objectives to be achieved in a drainage or subdrainage area and

2) evaluation of each measure in terms of costs versus benefits when applied toward achievement of these objectives.

Major improvements include flood and sediment detention structures, debris basins, storm sewers, open channel linings, reservoirs, irrigation systems, and drop-inlet structures.

Recently, high velocity conveyance channels have been used to control flood flows through developed areas. In addition to flood control, these devices reduce the necessary channel width and eliminate a channel erosion problem. The procedure is to construct a lined channel, usually concrete, designed for sufficient depth to carry critical flows. Critical flow is defined as the state of flow at which the specific energy is a minimum for a given discharge.

Economic Aspects of Sedimentation Control

Insufficient consideration has been given to the economics involved in sedimentation control. On one hand, not enough information is available by which to determine, on a sound basis, the actual costs which stem from soil erosion and sediment problems. On the other hand, little substantive research has been conducted which would provide criteria by which to judge the economic benefits which are derived from sedimentation control. Many such benefits are aesthetic in nature (i.e., "clean" lakes, mud-free playgrounds, etc.) and it is difficult to determine the economic value of such intangible benefits.

An important element lacking in making determinations concerning the economics of sedimentation is a method by which to judge the desirability (in cases where aesthetics are involved) and the effectiveness of using cost-benefit analysis in the field of sedimentation control. In many situations where conventional cost-benefit analysis prohibits application of control provisions, it may be desirable to explore the use of less expensive control methods which have not been excluded under the cost benefit ratios.

Urban and suburban areas in general have had little experience in connection with negotiating for federal and state sources of financial and technical assistance for sedimentation control. Most federal assistance programs in this field are either directed predominantly to rural areas, or apply to sedimentation problems only as being ancillary to other programs, such as drainage and flood control.

Similarly, local areas have had little experience in cost-sharing approaches to sedimentation control financing. Cost-sharing for financing control is feasible between state and local governments, between urban and suburban communities, and between private developers and local governments. Developing equitable cost-sharing formulas may be difficult in some instances because it is often difficult to determine the true cost of applying control devices. For example, very little research has been conducted to determine what the cost is to developers for applying sedimentation control to subdivision developments. In addition, it is difficult to determine the cost to local governments for inspecting such developments. Other information that is needed on basic cost factors include the current cost of removing sediment from waterbodies, and the current cost of conducting basic watershed research, such as the cost of soil surveys and soil mapping.

It is also difficult to determine the cost involved in adopting alternative approaches to conventional construction patterns in an effort to control sedimentation. For example, it has not been determined what the most economical procedure is for installing final drainage systems in new subdivisions, under conditions conducive to minimizing sedimentation problems.

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SECTION III

COMMUNITY ACTION GUIDEBOOK FOR SOIL EROSION AND SEDIMENT CONTROL

The following Community Action Guidebook has been written expressly for local government officials who, as a result of urban and suburban growth and development, are confronted with soil erosion and sediment problems. The guidebook describes various procedures that local officials can undertake to organize and implement sedimentation control programs.

The theme of this publication is that the growing soil and water problems in developing areas can be controlled if the proper management approaches are organized and put into action. This conviction is based on evidence gathered from empirical field studies where significant success in controlling sedimentation problems has been achieved.

The guidebook represents an attempt to investigate those features of on-going programs which are believed to be important to achieving effective sedimentation control, and to provide this information to other communities throughout the nation. The guidebook is divided into ten chapters, with each chapter addressing a specific aspect of control. A brief description of each chapter follows:

Chapter 1--Introduction. The initial chapter attempts to explain the nature and extent of the sedimentation problems facing this nation's growing suburban areas. Emphasis in this chapter is placed on the fact that sediment yields in this country are astonishingly high, and that the twin problems of erosion and sediment should be viewed as constituting a major threat to environmental quality.

Chapter 2--Organization. In the second chapter, some of the approaches which may be used in setting up and administering control problems are described. There are two major organizational features of control programs which might be noted. First, programs should be organized so that they have the capability of effectively controlling problems as they exist. The nature and extent of these problems should be a basic consideration when determining organizational patterns. Second, control programs should be organized in such a way as to include all interested and relevant groups and agencies.

Chapter 3--Areawide Approaches. The next chapter describes some of the areawide approaches that have been used with varying degrees of success throughout the nation. The areawide organizations discussed here include councils of government, flood control districts, conservation agencies, watershed organizations, areawide planning agencies, and river basin organizations.

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Chapter 4--Legal Authority. This chapter discusses the fact that effective local control depends largely upon whether or not local communities possess the necessary enabling legislation. Without this authority, local governments cannot acquire land, develop facilities, spend public funds, or regulate development activities.

Chapter 5--Planning. If communities are to enjoy orderly growth and at the same time prevent deterioration of their soil and water resources, they will need to make wise decisions related to the ways in which these resources are used. This chapter defines what is meant by erosion and sediment planning, and points out the ways in which such planning can help to avoid serious hazards.

Chapter 6--Public Acceptance and Support. In this chapter the importance of developing community acceptance of erosion and sediment control programs is discussed, and techniques and procedures that may be used in conducting education programs are described.

Chapter 7--Finance. Chapter seven is designed to illustrate how erosion and sediment control, as an integral part of an overall water management program, can be financed. It includes information on various approaches to funding control programs such as the use of bonds, assessments, tax sources, capital planning, and a number of other financial aspects. Financial and technical assistance available to local control programs is also discussed.

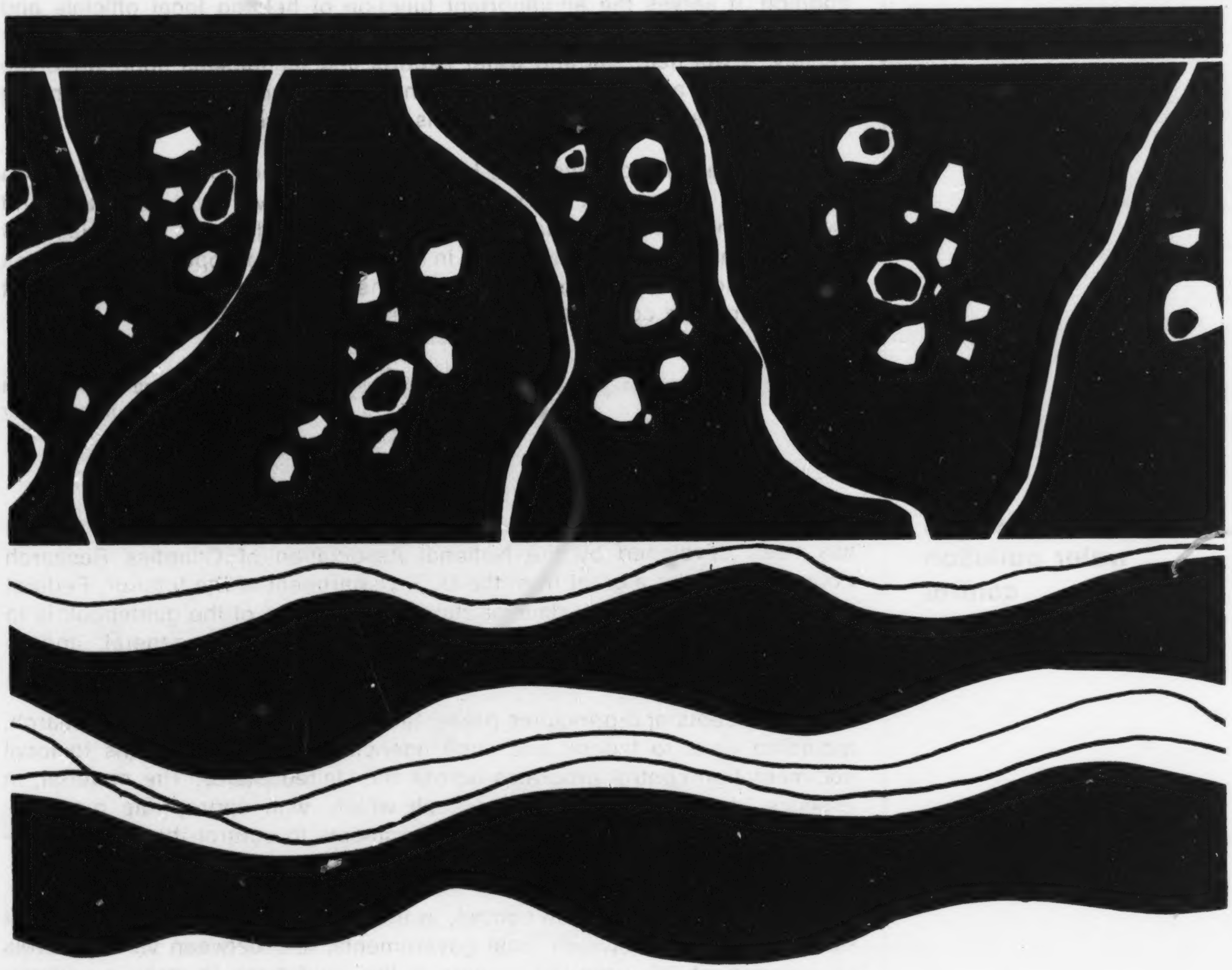
Chapter 8--Staffing. The success of control measures may depend largely upon how effectively the entire program is carried out by the personnel involved. The chapter on staffing attempts to describe some of the personnel requirements that such programs may need and discusses some of the training and recruitment procedures that may be used in developing personnel capabilities.

Chapter 9--Operations. This chapter has been devoted to a description of some of the operational approaches that are being used to control erosion and sedimentation. This chapter also provides information on various control devices which can be installed, including storm drainage systems, outlet channels, terraces, diversions, and others.

Chapter 10--Action Plan. The final chapter summarizes sedimentation control concepts, principles, and techniques and converts them into a general plan of action for local, state, and federal officials.

The "Community Action Guidebook for Soil Erosion and Sediment Control" has been distributed to over 20,000 local officials as an insert in the May 1970 issue of the American County, the magazine of the National Association of Counties (the pagination of the Guide appears according to its position within the magazine). In addition, several thousand copies of the guide have been disseminated to local officials through other means of distribution, and a limited number of copies will be available from NACORF upon request.

Community Action Guidebook for Soil Erosion and Sediment Control



by
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FOREWORD

national association of counties research foundation

Erosion and sediment, once thought of as rural problems, are causing extensive damage to the soil and water resources of developing communities. Sediment caused by careless development and construction has become one of the Nation's most serious sources of water pollution.

The National Association of Counties Research Foundation (NACORF), under contract with the U. S. Department of the Interior, Federal Water Pollution Control Administration, has developed this guidebook to assist local officials in their efforts to control growing sedimentation problems. Specifically, this guidebook will help local officials to organize, plan, finance, staff, and implement comprehensive sedimentation control programs. In addition, it serves the all-important function of helping local officials and administrators understand what is basically a technical problem; and conversely, it will help soil and water experts and technicians understand the administrative aspects of sedimentation control. This mutual understanding will be necessary if effective control is to be achieved.

Environmental problems have become critical, and cooperation between all levels of government will be required in a massive effort to restore and maintain environmental quality. The skills, knowledge and enthusiasm of local officials will be a key factor in this effort. We hope this guidebook will assist local officials in making wise management decisions, consistent with the growing concern for environmental quality.

Bernard F. Hillenbrand
Executive Director

federal water pollution control administration

The Community Action Guidebook for Soil Erosion and Sediment Control has been developed by the National Association of Counties Research Foundation under a grant from the U. S. Department of the Interior, Federal Water Pollution Control Administration. The purpose of the guidebook is to promote the concept of soil and water management in general, and to develop an understanding of sedimentation control principles in particular.

The concepts and principles presented are based on a year of research, including visits to federal and state agencies and fourteen visits to local sedimentation control programs across the United States. The material, in essence, describes a model approach which, with appropriate modifications, may be used by many local governments to control their sedimentation problems.

Successful sedimentation control, in the final analysis, will be dependent upon cooperation between local governments, and between various levels of government. We urge the readers of this guidebook to make a commitment to sound principles of soil and water management and to provide the initiative, energy, and cooperation needed for effective sedimentation control.

David D. Dominick
Commissioner

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Community Action Guidebook for Soil Erosion and Sediment Control

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PHOTO CREDITS – U.S. Department of Agriculture, Soil Conservation Service

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chapter one

Survey of the Problem

The growth of American suburbia has received its impetus from a combination of forces, including American wealth, the automobile and the initiative, energy and technical expertise of American industry. More and more, it is being recognized that these forces have propelled suburban development forward without sufficient consideration being given to the impact that such growth is having on man's relationship with his natural environment.

In the nation's developing suburban areas, and urban areas, extensive alteration of the landscape and intensive use of the land have resulted in serious imbalances between soil and water. As a result, erosion and sediment, once thought of as exclusively rural problems, have become serious problems in urban and suburban America.

Despite the fact that suburban erosion and sediment cause extensive pollution of water bodies, cost millions annually in damages to homes, roads and recreational areas, and in some areas even threaten domestic water supplies, very few localities in the nation have organized and implemented erosion and sediment control measures. The purpose of this chapter is to describe the nature of man-made erosion and sediment problems in urban and suburban areas, and to discuss why it is important for local communities to organize erosion and sediment control programs.

DESCRIPTION OF THE PROBLEM

Sedimentation involves the processes by which mineral or organic matter is detached, transported or deposited by moving water, wind or gravity. The detachment process is erosion, and the detached particles being transported or deposited are considered sediment.

The amount of sediment yielded on a national scale is astonishingly high. It is estimated that the total amount of sediment moving into the nation's rivers, lakes, estuaries, reservoirs, streams and other water bodies reaches four billion cubic yards each year.[1] Sediment yields from large watersheds in many parts of the country range from three to ten tons per acre per year. In addition, the nation's roadsides produce over 56 million tons of sediment annually.[2] The President's Task Force on the Quality of the Environment reported that stream channel erosion moves sediment into streams at the rate of about 500 million tons a year.[3] In the nation's reservoirs, annual deposits of sediment are estimated to exceed 850,000 acre-feet.[4] This is approximately equivalent to the combined land area of Rhode Island and Washington, D.C., one foot deep.

Erosion and sediment are expensive problems. It is estimated that each year over one-half billion cubic yards of sediment are dredged from waterways.[5] The U.S. Department of Agriculture reports the total cost of such sediment damage and dredging to be approximately 500 million dollars. In addition, it costs approximately 16 million dollars each year just to remove sediment from irrigation ditches. These figures do not take into account the damages to soil ($800 million annually in agricultural areas), and to homes, roads, businesses, bridges, yards, and recreational areas.[6]

Sources of Sediment

Soil erosion, the displacement of soil by the force of moving water, wind, or gravity, accounts for the greatest bulk of suspended materials in the nation's waters. In addition to the fact that most sediment is derived from eroded soil, such erosion is a serious and costly problem in itself. Soil erosion has been referred to as a silent thief which robs topsoil from farms, leaves gaping scars in landscapes, undermines houses, roads and bridges, and contributes to flooding. Soil erosion and sediment are twin problems, linked by the pull of gravity. It is not possible to separate the problem of sediment damage from the problem of soil erosion. Damage is inflicted at the scene where soil is eroded, where it is washed downstream, and where sediment remains suspended or comes to rest.

Efforts to control sediment pollution must be concerned not only with treatment of water which is already affected by sediment, but also with controlling the massive amounts of soil being washed into waterways each day. The control of soil erosion is a key element in upgrading the quality of the nation's water resources.

Efforts to control soil erosion should focus on three broad categories of land disturbance. First, it should be recognized that a significant proportion of soil erosion is of the "natural" or geological type. Natural erosion occurs as the result of interaction among various environmental elements. Land untouched by man is susceptible to erosion caused by wind, precipitation, and moving water.

Man's agricultural, forestry and mining activities produce another type of erosion. In the United States, an estimated three billion tons of soil are washed from cultivated and overgrazed ranges each year.[7] Sediment yields from agricultural lands in watersheds along the lower Mississippi, for example, average about ten tons per acre per year. In the Southeast, sediment yields average about seven tons per acre per year. It is suggested by some sources that about one ton per acre per year is an acceptable sediment yield rate from croplands.[8] Therefore, even though considerable success has been achieved in controlling agricultural erosion through scientific farming methods such as contour farming, strip cropping and terracing, the amount of soil eroding from agricultural lands continues to be extensive.

A third cause of soil erosion is associated with suburban development. At the present time, more than 4,000 acres of agricultural land are being converted to other uses daily, such as houses, roads and highways, schools, businesses, industries, and other improvements.[9] Development on such a massive scale requires extensive disturbance of land involving the movement of millions of tons of topsoil and vegetation. As a consequence of such development, natural watershed drainage patterns are often disrupted without providing appropriate compensation.

Evidence being made available by current research suggests that sediment yields in areas undergoing suburban development can be as much as five to 500 times greater than in rural areas.[10] A report published in 1963 by the Interstate Commission on the Potomac River Basin estimated that sediment from urban developments in the Potomac Basin ran as high as 50 times that yielded from agricultural lands. In some urbanizing areas along the Potomac, the sediment yield was as much as 39 tons and more per acre per year.[11] The 14,870 square miles of land draining into the Potomac river basin, for example, contribute two and one-half million tons of sediment to the Potomac estuary each year.

Erosion in suburbanizing communities may be 500 times greater than in rural areas.

Sedimentation in Suburbia **FAIRFAX COUNTY, VIRGINIA**

Located adjacent to the growing Washington, D.C. metropolitan area, Fairfax County, Virginia has experienced extensive suburbanization during the last ten years. During this time, Fairfax County has changed from a rural to a predominately suburban area.

The suburbanization process in Fairfax County has been characterized by massive movement of topsoil, and the replacement of natural vegetation by streets, highways, buildings, and many other changes. As a result, many areas within the county have been inflicted with serious sedimentation problems. One such area is the Lake Barcroft Community where local citizens and groups have waged an uphill struggle for several years to protect their 135-acre lake from massive sediment loads. The lake, which constitutes an aesthetic and recreational community asset, was found several years ago to be filling in with soil washed from unprotected construction sites upstream.

Sediment studies conducted on Lake Barcroft explain why citizens viewed the future of their lake with alarm. Technical studies revealed that each square mile of suburban construction upstream contributed an average of 25,000 tons of sediment to the lake. The deterioration of the lake was a threat to its recreational value, as well as to the property values.

Concerned citizens and groups in the community organized to combat the sedimentation problem. Initial efforts to stop sediment at its source–upstream construction sites–were stymied, however, because no legal provisions existed by which sediment producing activities could be regulated. To save the lake, local citizens and groups were forced to dredge large loads of sediment. The Lake Barcroft Community Association, in cooperation with other active groups, has raised and spent over $300,000 to remove sediment from the lake and to construct improved drainage. Currently, about 15,000 cubic yards of sediment are dredged from Lake Barcroft every three years.

Not content to dredge sediment on a permanent basis, local leaders mounted an effort to place legal responsibility for sediment damage on the parties causing soil to erode. This effort, involving teamwork among several local groups, culminated in the adoption of official erosion and sediment control measures by the county government in 1966.

The Fairfax County sediment control program is considered by many to be one of the most effective of such local programs in the nation. It is grounded in county law, and is staffed and operated by existing local agencies, including the Northern Virginia Soil and Water Conservation District, and the County Department of Public Works, the County Planning Commission, and the Department of County Development.

The experience of Fairfax County clearly illustrates how suburbanization can produce costly sedimentation problems, and how these problems can be brought under control. The Chapter on Legal Authority includes a description of how the Fairfax County sedimentation control program is operated.

Even after development, erosion and sediment continue to plague suburbia. In areas of intense suburban growth, it is common for flat surfaces such as roads, roofs, parking lots, and lawns to replace natural vegetation by close to 100 per cent. As a result, more water runs much faster off the entire suburban area frequently causing downstream flooding and erosion.

In addition, a type of sediment, sometimes referred to as "sanitation debris," is prevalent in all urban and urbanizing areas. Sanitation debris, or "street litter," consists of dirt and dust, leaves, twigs, grass clippings, tin cans, tree branches, material eroded from buildings and sidewalks, fallout of air pollution particles, household refuse and other streetwash. Such litter becomes sediment pollution when it is carried into waterbodies by storm runoff, thawing, or by street washing operations.

The fact that street litter constitutes a major source of water pollution is not widely known. A recent study reports that the average amount of street litter in those areas examined varied from 0.5 to eight pounds per 100 feet of curbing per day.[12]

The huge sediment yields in suburbia clearly illustrate that suburban development does not take place in a void, but instead occurs within watersheds where soil and water interact with intensive force. One inch of rain, for example, falling on a one square mile surface has a total weight of about 70,000 tons.[13] This means that a watershed which receives 20 inches of rain a year will receive an impact of about 1.4 million tons of water weight per square mile per year. When soil is exposed to this force, the resulting damage can be expensive and irreversible.

Effects of Sediment

Sediment has many harmful effects on water which serve both to impair water quality and to reduce the quantity of available water supplies.

By interfering with the penetration of sunlight, some types of sediment particles reduce the capacity of water organisms to absorb waste materials. As a result, the ability of water to purify itself is impaired. The oxygen content of water is also reduced by sediment particles, which endangers the survival of aquatic life such as fish and plants. In several areas of the country, excessive silt has covered the spawning beds of fish, causing a decline in water-based industries.

Sediment also threatens public health and safety by carrying radioactive substances, nitrates, pesticides, and other toxic materials into public water supplies. In addition, harmful bacteria often cling to, or are absorbed by, sediment particles which pose health dangers to water users. Excessive sedimentation produces stagnant streams, lakes and ponds which may endanger community health. In the Southeast, for example, many years of effort to control mosquito breeding have been lost because sediment has filled drainage channels. Public safety is frequently endangered due to the many floods occuring each year because sediment has choked flood prevention reservoirs, leaving little space for storm waters.

Excessive sediment also interferes with water treatment operations. In the many urban areas having combined storm and sanitary sewer systems, increased runoff from rainstorms often overburdens treatment facilities, and, consequently, untreated sewage is carried past treatment plants into rivers. In many such areas, increased runoff caused by suburban growth has made storm water and sewer systems completely inadequate. This problem is far more extensive than is generally realized. The Soil Conservation Society of America reports that "suspended solids reaching the nation's streams by way of surface runoff are estimated to be at least 700 times the volume of sewage discharges."[14] In terms of volume, sediment ranks above sewage, industrial wastes, and chemical pollution combined.

Sediment also damages recreational waters, thereby decreasing facilities at a time when the demand for outdoor recreation is expected to triple within 30 years. Sediment inflicts millions of dollars of damage on homeowners in the form of cleanup and repair costs and in decreased property values. During storms, sediment in rushing streams alters normal drainage flow which in turn damages trees and other plant life. After storms, sediment can be observed covering streets, filling drainage channels and clogging sewer lines.

The cost of water treatment increases when sediment interferes with water supplies. The annual cost of removing excess turbidity from public water supplies is estimated to be 14 million dollars.[15] Suspended sediment can also cause damage to power producing equipment which in turn causes higher electricity costs.

One of the more serious effects of sediment is that it causes a considerable amount of water to be displaced in the nation's water supply reservoirs. The cost of storage space lost to sediment is high – about 50 million dollars annually.[16] More importantly, about 850,000 acre feet of storage space is lost at a time when the need for potable water supplies is expected to double within 30 years.

CONTROLLING URBAN AND SUBURBAN SEDIMENT

The causes of urban soil erosion differ considerably from the causes of agricultural erosion. In agricultrual areas, soil erosion occurs during the activities involved in food and fiber production and by other agricultural activities. In urban areas, the causes of erosion and sediment are much more complex, involving the activities of numerous organizations and different levels of government. Homebuilding, for example, is one of the primary causes of urban sediment, and homebuilding operations involve a complex series of logistical, administrative, and legal considerations. The construction of highways and other public facilities have equally complex operational considerations which make urban sediment far more difficult to control than agricultural erosion.

Technical Means Are Available

Many of the technical means by which suburban sediment and erosion can be controlled are available. While soil erosion cannot be completely controlled, there are documented cases where the application of technical measures has decreased erosion and thereby reduced sediment by a significant amount. Current research and experimentation suggest that many of the same techniques used successfully to control erosion in agricultural areas are similarly effective in urban areas. The Chapter on Implementation and Control discusses some of these techniques. What is most urgently needed at this time is the development and adoption of the organization procedures which can muster and apply the technical knowledge that is available.

Erosion and Sediment Are Local Problems

Erosion and sediment inflict heavy damages upon local governments, businesses and citizens. The financial costs to local communities caused by these problems have been staggering in many areas. These costs are born by the local communities either through higher taxes or direct expenditures to repair damage to private property. Many of these costs are unnecessary in that through proper planning and organization, much of the damage can be prevented.

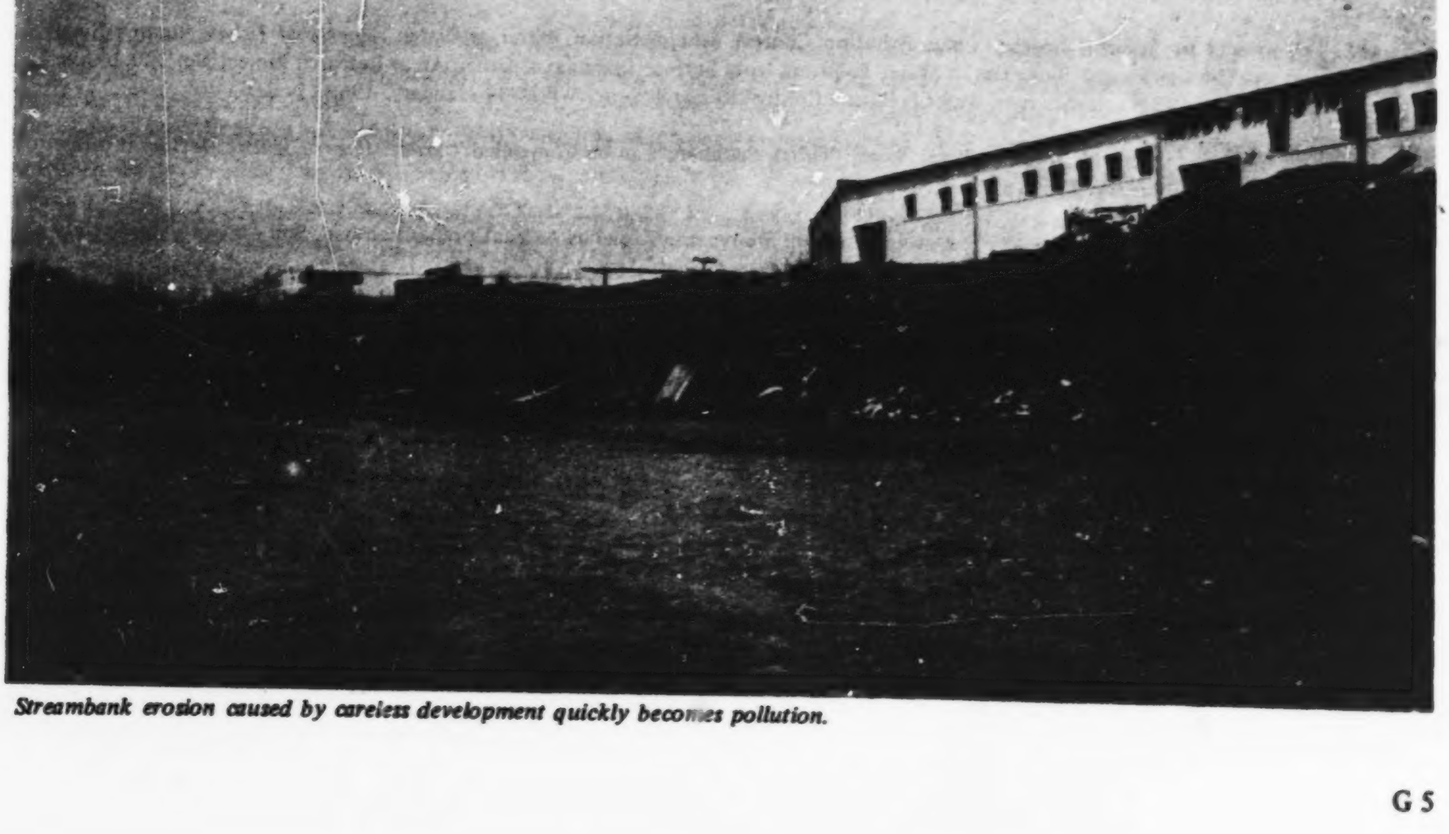
Increasingly, it is being recognized that local officials must assume their share of the responsibility for managing the natural resources of their community. The federal and state governments can and do offer guidelines and assistance to local areas. However, the bulk of the responsibility for proper management of the environment must come from local leaders, concerned citizens, professional conservationists, businesses, industries, and most importantly, local officials. The role of local officials is important in this connection because they are primarily responsible for making the policy decisions with regard to how local resources are allocated and used. As the demand on local resources, such as land, increases, the demand for wise decisions with regard to their use will also increase.

SUMMARY

This chapter explains, in general terms, the nature and extent of the erosion and sediment problems facing this nation's growing urban and suburban areas. There are several important points which deserve to be emphasized.

An important characteristic of the sedimentation process is that, although the problem is widespread in the United States, not all areas are affected in the same way or to the same extent. Many areas undergoing suburban development have experienced erosion or sediment problems only to a limited degree, while in other areas they are very serious and costly. Types of problems also vary. Some areas, such as portions of the West Coast, may be primarily concerned with mud slides, whereas other localities may have no erosion problem, but instead receive heavy sediment loads from localities upstream. Still other areas experience problems with sediment pollution from mining activities.

In addition, it is important that the soil erosion and sediment problem in this country should be viewed as constituting a substantial portion of the overall deterioration of our environment. Although it is not universally recognized as such, sediment is a pollutant. Many authorities clearly indicate that sediment has several of the same effects on water as do the more widely recognized pollutants. In connection with this, it is important to note that sediment pollution is a much more extensive problem than is generally recognized. Moreover, as the nation's population climbs to a predicted 300 million by the year 2000, sediment pollution caused by development, redevelopment, and construction activities will increase on a massive scale, unless effective control programs are implemented.



Streambank erosion caused by careless development quickly becomes pollution.

1. Environmental Currents, "Sediment is the Nation's Main Water Pollution Burden." Environmental Sci. and Technol., 2, 993 (1968), Cited in "Bottom Deposits," Journal Federal Water Pollution Control Federation, Annual Literature Review, 41 (June, 1969), 1093.

2. D.A. Williams, "A No-Man's Land in Erosion Control," *Soil Conservation*, U.S. Department of Agriculture, XXXII (April, 1967), 215.

3. *Ibid.*

4. Position Statement by Sub-Committee to Develop Position Statement, Cornelius A. VanDoren, Chairman. Soil Conservation Society of America, (No Date), p. 1.

5. "Sediment: It's Filling Harbors, Lakes and Roadside Ditches," Soil Conservation Service, U.S. Department of Agriculture Information Bulletin No. 324, December, 1967, 3.

6. American Water Resources Association. *Proceedings of the Second Annual American Water Resources Conference* (University of Chicago, November, 1966), p.82.

7. W.E. Bullard, "Effects of Land Use on Water Resources," *Journal Water Pollution Control Federation*, (April, 1966), 646.

8. American Water Resources Association. *Proceedings of the Second Annual American Water Resources Conference* (University of Chicago, November, 1966) p. 80.

9. Address by Assistant Secretary of the Interior, Carl L. Klein before the National Conference on Sediment Control, Washington, D.C., September, 1969.

10. Position Statement by Sub-Committee to Develop Position Statement, Cornelius A. Van Doren, Chairman. Soil Conservation Society of America, (No Date), p. 1.

11. *A Program for Sediment Control in the Washington Metropolitan Region.* Interstate Commission on the Potomac River Basin, Technical Bulletin 1963-1 (Washington, D.C., 1963), p. 18.

12. U.S. Department of Interior, Federal Water Pollution Control Administration, *Water Pollution Aspects of Urban Runoff*, Final Report on The Causes and Remedies of Water Pollution from Surface Drainage of Urban Areas-Research Project No. 120, by the American Public Works Association. Water Pollution Control Research Series WP-20-11 (January, 1969), p. 2.

13. Interstate Commission on the Potomac River Basin, "Urban Sediment Can be Controlled," *Proceedings of Winter Meeting* (College Park, Maryland, February, 1966) p.19.

14. Position Statement by Sub-Committee to Develop Position Statement, Cornelius A. VanDoren, Chairman. Soil Conservation Society of America, (No Date) p. 1.

15. American Water Resources Association. *Proceedings of the Second Annual American Water Resources Conference* (University of Chicago, November, 1966), p. 82.

16. *Ibid.*

chapter two

Organizing an Erosion and Sediment Control Program

Despite the fact that erosion and sediment cause extensive pollution of water bodies, cost millions annually in damages to homes, roads and recreational areas, and in some areas even threaten domestic water supplies, very few localities in the nation have organized and implemented erosion and sediment control measures. Organizing an erosion and sediment control program in suburban and urban areas is a difficult task. There are several reasons for this, the primary one being that controlling soil erosion requires that certain limitations be placed on various kinds of land use. This procedure involves issues that are political and administrative as well as scientific and technical.

Some areas experiencing heavy sediment yields have, nevertheless, succeeded in bringing the problem under control to a substantial extent. This suggests that the problem of controlling erosion and sediment is not lack of technical capability, but instead is a matter of human initiative, and of determining how technical knowledge can be organized, financed, administered, and implemented. The purpose of this chapter is to discuss some of the organizational problems associated with controlling erosion and sediment and to describe some of the methods by which control efforts can be organized at the local level.

ORGANIZING FOR SEDIMENTATION CONTROL

The purpose of organizing for erosion and sediment control is to provide a consistent, comprehensive, and effective method of controlling erosion and sediment while, at the same time, causing as little disruption as possible to normal suburban and urban development and redevelopment. The organized approach stands in contrast to control efforts which do not coordinate all activities, groups, individuals, and agencies which have a bearing on the erosion and sediment problem.

Sedimentation control programs may be organized in many different ways. Regardless of the organizational form used, control programs should consider two basic factors.

The first condition to be considered is the nature and extent of erosion and sediment problems. This means that research must be conducted to determine where and how much soil is being eroded, what the effects of sediment are, and what control measures can be taken.

Another basic factor which must be considered when organizing a sedimentation control program is what legal guidelines – federal, state and local – are relevant. Local governments need to determine what authority exists before organizing, and if local authority to organize is lacking, it will be necessary to obtain it through state enabling legislation. For more information on legal guidelines, see the Chapter on Legal Authority.

THE TASK FORCE APPROACH

Establishing control over suburban and urban sedimentation may be difficult because a control program affects many different groups within a metropolitan or suburban setting. Efforts to control erosion and sediment may affect land use, land-use planning, construction activities, drainage control policies, and the zoning process. Developers, conservation agencies, citizens groups, water management organizations, local and state governments, and in cases where inter-state waters are affected, the federal government will all have an interest in, or may be affected by, a sedimentation control program.

By organizing a task force, composed of representatives of these groups, it is possible to develop a control program which will encourage the involvement of many community interests. This approach, referred to as the task force approach, has been used successfully by several counties, and it offers several advantages.

First, by involving as many groups as possible, the chances are lessened that the program will separate those who cause sedimentation problems from those who are attempting to correct them. In most cases, these positions are not clear, and, in many cases, they are interchangeable; that is, those who create sediment, such as homebuilders, may also be attempting to control sediment, and those who are responsible for controlling sediment, such as local governments, are also causing it. Thus, a value of the task force approach is that it helps to promote a unified and realistic recognition of the nature of the erosion and sediment problem.

Another reason for obtaining involvement of diverse groups in the control program is that the manpower resources available to the program can be increased by utilizing personnel from various participating groups. To be effective, a sediment control program requires professionally trained personnel, such as soil scientists, agronomists, hydrology experts, and engineers. The task force approach makes available personnel trained in various disciplines when they are needed. For example, soil scientists and other technically trained personnel are often available on a cooperative basis from local conservation districts; and hydrology experts are available from state departments of water resources; departments of public works are normally staffed with professional engineers, as are the homebuilding organizations; and planning agencies can contribute professional planners from their staffs. Citizens groups are also sources of manpower and can carry out important responsibilities in connection with public education programs.

With this trained manpower available, the task force can coordinate and carry out much of the initial research needed to develop a control program; such as research on the physical and legal factors discussed above. Another reason for encouraging involvement is to reduce resistance. When several groups work together to solve erosion and sediment problems, the resulting control program is likely to be more effective. This is so because when a group participates in the planning and organization of a program, they are less likely to object to the implementation of the program.

THE ROLE OF LOCAL GOVERNMENT IN ORGANIZING THE TASK FORCE PROGRAM

Establishing control over erosion and sediment involves making decisions with regard to how local resources are to be planned, allocated and used. Specifically, a sediment control program will frequently affect land use policy, the quality of water resources, and will require the use of local funds to support the control effort.

A sedimentation control program therefore represents a form of soil and water resource management which must be regarded as an important responsibility of local government officials. The primary responsibility of local officials is to develop the organizational and procedural forms for gaining control over erosion and sediment, and to assume a leadership role in the control program. The following information describes some of the important aspects of organizing a control program on a task force basis.

Development of a comprehensively organized program should include the following five aspects:

(1) formal recognition by local elected officials of the need for erosion and sediment control;
(2) formulation of administrative and legal controls;
(3) assignment of specific responsibilities to local agencies;
(4) provisions for on-site inspection of sedimentation control efforts, including provisions for maintenance of control devices;
(5) program evaluation.

Each of these aspects is discussed in more detail below.

A Formal Recognition

Formal recognition of the need for erosion and sediment control by local elected officials serves several purposes, each of which is important to effective control. First, formal recognition represents an official statement that erosion and sediment problems do exist. In order for local agencies to effectively control erosion and sediment, they will need the support of local officials who have the responsibility for making policy decisions related to land-use activities. Second, a formal recognition by local officials serves the purpose of establishing the position of the "public interest" in favor of erosion and sediment control. This, in effect, forms the justification for specific legislation designed to control erosion and sediment. A third purpose served by a formal recognition of control is related to timing. Once erosion occurs, and sediment is

SEDIMENT CONTROL RESOLUTION

COUNTY COUNCIL
MONTGOMERY COUNTY, MARYLAND

WHEREAS. The people of the county have recognized the problems of soil erosion by creating the Montgomery Soil Conservation District, now operating a voluntary conservation program in the open areas of the county, and

WHEREAS. The shifting of land use in Montgomery County from agriculture to urban and suburban development has substantially increased silt and sediment problems on the lands and in the streams and lakes in the county and in the Potomac River, and

WHEREAS. Sediment from developments has been declared a pollutant within the meaning of Art. 96A Ann. Code of Maryland 1957 Ch. 73, Laws of Md. 1964 entitled, "Water Resources", (a legal opinion by the office of the Attorney General of Maryland) and

WHEREAS. Property owners suffering unreasonable damage from sediment deposition or flooding of property at downstream sites as a result of disturbance of watershed areas upstream often must seek protection by the courts against such damages.

NOW THEREFORE BE IT RESOLVED:

1. That it is the policy of Montgomery County, Maryland, to provide for control of soil erosion particularly in the urbanizing areas of the county by the adoption and implementation of a Sediment Control Program for developments on the public and private lands of the county.

2. That the various departments and branches of the county government are directed to develop policies and procedures and to implement this program and the Builders Advisory Committee is requested to work with the county agencies and the builders to assist in this work.

3. That the landowners and developers of Montgomery County are urged to cooperate in this program and to abide by its procedures and regulations.

yielded, prevention is impossible, and costly repairs usually result. A formal recognition of control serves to notify the general public that, henceforth, efforts will be made to control erosion and sediment.

A formal recognition of the need for control is not in itself normally legally binding. It closely resembles an official policy statement which establishes a non-legal position that local officials vote to assume. Such a position, however, can serve as a basis for subsequently establishing specific legal responsibilities.

Formulation of Administrative and Legal Controls

It is not usually possible to develop a sedimentation control program within a short period of time. Hastily developed provisions may be ineffective if they are either too demanding or not demanding enough. One characteristic of successful control programs now in operation is that the legal provisions and administrative procedures which constitute the backbone of control programs have not been abruptly imposed but instead have been developed to their present form over a long period of time.

Compliance with sediment control legislation will be difficult to enforce unless the community is aware of and understands the need for regulation. A period of time will be needed for the members of the community to become acquainted with the control program and how it affects them. This time period can also be used to make

Organizing a Program

MONTGOMERY COUNTY, MARYLAND

Contiguous with the District of Columbia, Montgomery County, Maryland is experiencing a large measure of the expanding suburban development of the Washington Metropolitan area. Development has produced the problem of excessive erosion of soil with losses ranging up to 2,300 tons per square mile per year in some watersheds; while smaller areas lose soil at many times this rate. This is due to the rolling topography, the intensity of rainfall, the erodibility of the soils, and the extent and duration of exposure of bare soils during development.

Control for the resulting sediment began receiving serious county attention with initiation of the Rock Creek Watershed Project in June, 1964. The project was designed to create two multipurpose lakes through the construction of two dams. Prior to construction of the second dam, Maryland Soil Conservation Service officials became acquainted with serious damage caused by sediment to Lakes Barcroft and Accotink in Fairfax County, Virginia. The similarity of these lakes to the planned multipurpose lakes of the Rock Creek Watershed Project was noted. In an effort to prevent similar damage in the Rock Creek Watershed Project, the Soil Conservation Service requested the Montgomery County Council to state its zoning and erosion control enforcement intentions in the watershed above both dams as a condition to federal funding of the second dam. Subsequently, the County Council appointed a sediment control task force consisting of the following agencies:

1. *Suburban Maryland Home Builders Association, representing land developers and the building industry;*
2. *Maryland-National Capital Park and Planning Commission, the bi-county agency responsible for the preparation of Master Plans and the administration of zoning and subdivision regulations;*
3. *Montgomery Soil Conservation District, the agency charged with the responsibility for the promotion of wise land use and adequate land treatment for erosion control;*
4. *Washington Suburban Sanitary Commission, a bi-county agency responsible for providing sewer and water facilities.*

In the Spring of 1965, the task force presented a voluntary sediment control program to the County Council. On June 29, 1965, the sediment control program developed by the task force became county policy by adoption of Montgomery County Council Resolution No.5-1954. County department heads were charged with responsibility for developing in-house policies and procedures designed to implement this program. The Council solicited the voluntary cooperation of the building industry.

Experience with the voluntary program indicated the need for improving compliance with its principles during private construction activities. Thus, two years after sediment control became a stated county policy it also became mandatory through adoption by the County Council of amendment (i) to section104-24 of the "Subdivision Regulations for the Maryland-Washington Regional District within Montgomery County." The amendment designates the Montgomery Soil Conservation District as the technical authority in the program and the county department of public works as the agency responsible for ensuring that developers install sediment control measures approved by the district.

Formal review of the first full year of operation of the mandatory program by the task force resulted in further education efforts and a general tightening up of enforcement efforts. This was followed by additional training for inspection personnel of the county department of public works, with a view toward promoting a better understanding of the technical principles of erosion and sediment control, and an improvement in enforcement.

adjustments in the program to meet unanticipated problems. Accordingly, it may prove helpful to launch the program on a voluntary basis in order that various parties can make appropriate adjustments. Legal provisions and administrative procedures can then be made more firm at a later date when initial difficulties have been worked out. A balanced and flexible approach at this stage of the program's development may be important to overall success.

For many types of urban and suburban erosion, controls may be implemented by placing appropriate stipulations within subdivision regulations. These stipulations set in motion a series of administrative and operational activities designed to control sediment yields by limiting erosion from subdivision construction sites. Some local governments have curtailed erosion and sediment from housing developments by stipulating within their subdivision regulations that homebuilders must include within their preliminary subdivision plans adequate conservation provisions. The preliminary plans are reviewed by appropriate local agencies for approval and recommendation. In this way, protection against erosion and sediment is built into the subdivision planning process and protection can be provided before construction begins.

It may be necessary to make use of grading regulations in cases where grading of land will contribute to the erosion and sediment problem. The bulk of urban and suburban sediment is derived from land that is graded, then left exposed for weeks, months, or even years before construction begins. Timing of the phases of construction is an extremely important factor in preventing erosion. A basic principle of prevention is to leave a minimum amount of land exposed for the shortest time practical.

Grading regulations may also be used to regulate such practices as construction during rainy seasons; the depth to which grading operations may cut the soil; the use of borrow pits; filling and sloping operations; and may require that grading be carried out with respect for topographical features and natural vegetative cover. Normally, the administration of grading regulations is a function of the department of public works.

In addition to subdivision and grading regulations, other administrative and legal methods that local governments can use to help control sedimentation include drainage regulations, land-use planning, and certain types of zoning. Drainage regulations can be used to ensure that adequate storm drainage systems are provided in all new subdivisions. It is important that these drainage systems be capable of accommodating the changed hydrology of the watershed as development progresses.

Planning and zoning are closely related to sedimentation control efforts. Most importantly, land-use planning and zoning need to be premised on soil and water capabilities. Because the relationship between sedimentation control efforts and planning and zoning is complex, it is discussed in more detail in the Chapter on Planning For Erosion and Sediment Control.

Assignment of Responsibilities

Once appropriate regulations are adopted, they will need to be implemented by assigning administrative responsibilities to local agencies. The administrative assignments may differ from place to place in accordance with physical, historical, legal, political, organizational, financial, and demographic variations.

Here, soil erosion caused by water is a result of the construction of a new school on sloping land, with no provision for erosion of for sediment control.

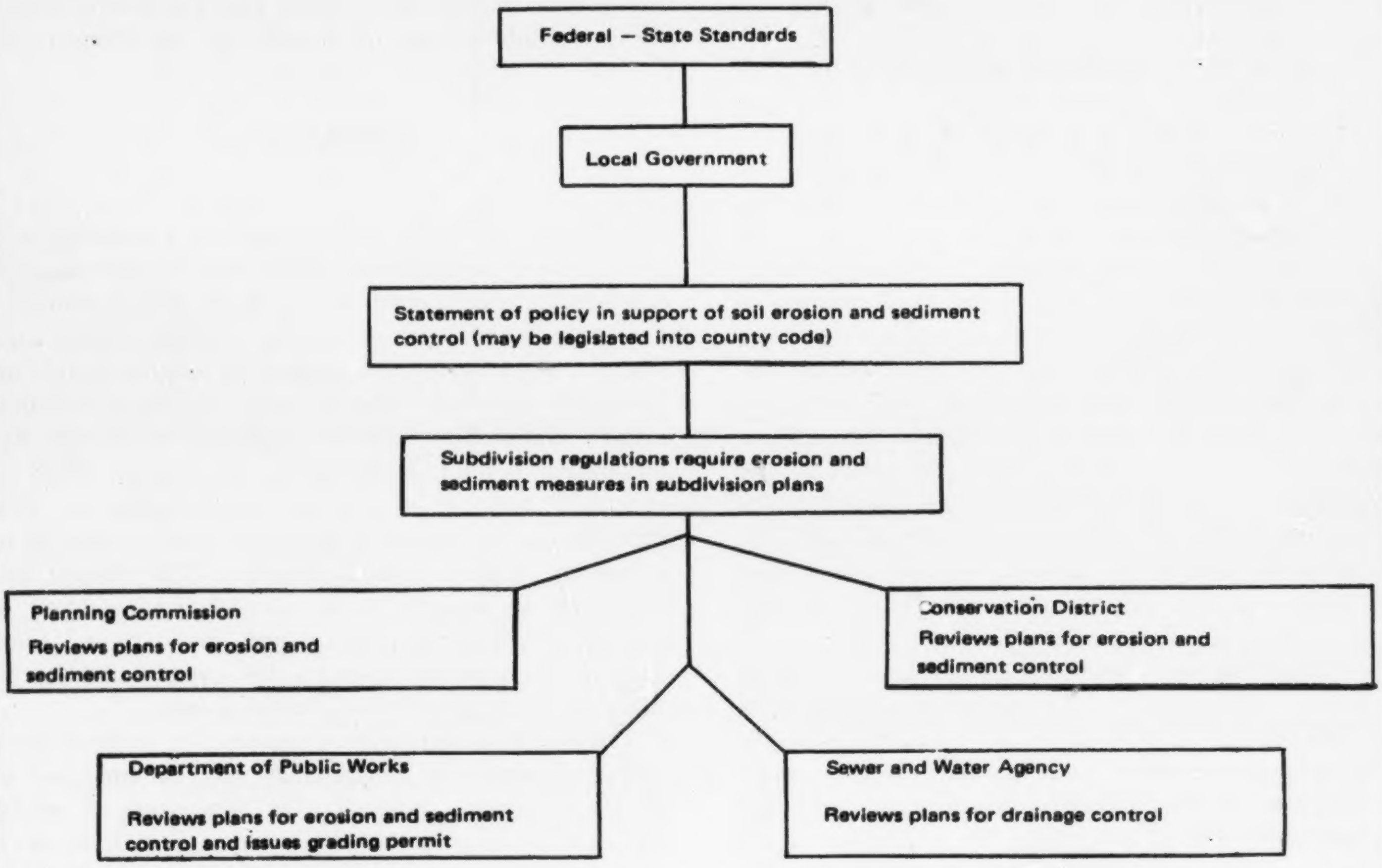
Under the task force approach, responsibility for administering controls is shared by several local agencies. A frequently used approach is to require that the local planning commission review the subdivision plans to evaluate the probable effectiveness of erosion control measures proposed by the builder. Frequently, copies of the subdivision plans are made available to the department of public works where they are reviewed for erosion control (as well as for other items) by professional engineers. In some control programs, subdivision plans are also forwarded to local conservation districts where soils experts and other professionals review proposed control measures and make recommendations for improvement when necessary. Other local agencies, such as sewer and water agencies, are sometimes also included in the review process. This process is illustrated in Figure 1.

There are sources of erosion and sediment other than those which are caused by private developers. Construction and use of public facilities, such as sewers and public buildings and especially highways are major causes of suburban and urban soil erosion. To be effective, a control program will need to control these as well as others.

Highway erosion is widespread in the United States, and various technical means have been developed to help control this costly problem. In many instances, highway departments can receive technical assistance from local conservation agencies. This is sometimes arranged by intergovernmental agreements between appropriate local agencies. Intergovernmental agreements can also be used in efforts to control erosion from construction of public facilities, such as schools and other public buildings, and sewers. In addition, intergovernmental agreements can be employed to coordinate municipal and county erosion control efforts. This aspect of a control program is discussed in the Chapter on Legal Authority.

Figure 1

How Subdivision Plans May Be Reviewed for Erosion and Sediment Control


Federal – State Standards
Local Government
Statement of policy in support of soil erosion and sediment control (may be legislated into county code)
Subdivision regulations require erosion and sediment measures in subdivision plans
Planning Commission
Reviews plans for erosion and sediment control
Conservation District
Reviews plans for erosion and sediment control
Department of Public Works
Reviews plans for erosion and sediment control and issues grading permit
Sewer and Water Agency
Reviews plans for drainage control

The chart illustrates how, in the task force approach, various local agencies share erosion and sediment responsibilities with regard to subdivision developments. Note that responsibilities may be assigned in whole, or in part, in accordance with the specific capabilities possessed by each agency. This process should not be permitted to cause unnecessary delay in review schedules. (Chart is illustrative only, as structures may vary throughout the United States)

In order to achieve comprehensive erosion and sediment control, sediment from public as well as private causes will need to be curtailed. It is important that public agencies set an example by controlling sediment caused by their own construction activities. The financing of private and public control is discussed in the chapter on Finances.

On-Site Inspection and Maintenance

Providing a capability to conduct on-site inspections of development and construction activities is an important function of local government. The inspection function provides assurance that on-site activities are proceeding in compliance with approved plans, and applicable rules and regulations.

With regard to erosion and sediment control, inspection ensures that erosion and sediment control measures, specified in approved project plans, are properly provided, and that unanticipated sedimentation problems are compensated for. The inspection function for erosion and sediment control may be made part of the normal inspection procedures of the local government, utilizing existing agencies and personnel. Crucial, however, to effective on-site inspection is proper personnel training in various aspects of sedimentation control.

Maintenance of control measures should also be provided for in the program. When developing an organizational structure for sedimentation control, maintenance responsibilities should be made a part of the general maintenance operations of the local government, utilizing existing agencies and personnel. Again it should be noted that training of personnel will be essential. For more information on personnel training, and on various maintenance operations, see the Chapter on Personnel and the Chapter on Implementation and Control, respectively.

Program Evaluation

Another important component of a control program is perodic evaluation of its overall effectiveness. An objective assessment of the program's effectiveness can lead to a determination of what modifications may be needed to improve erosion and sediment control.

The evaluation process should address at least the following items:

(1) Estimation of how much erosion and sediment have been reduced as a result of the program, and an analysis of how far the program has gone toward reaching its objectives.
(2) What are the strong and weak parts of the program.
(3) What are the operational needs of the program during the next evaluation period.
(4) What organizational or administrative improvements are needed.

It may be desirable for local government officials to encourage the participation of various groups in carrying out the evaluation process. An "evaluation committee" could be formed which could be assigned responsibility for conducting periodic evaluations. The evaluation committee should have members skilled in both the technical and administrative aspects of sedimentation control. The committee might include local elected officials, the sedimentation task force members, representatives from conservation groups such as the Isaac Walton League, citizens' organizations, and other interested groups.

Too often, the evaluation phase of program, is regarded as being unimportant. In programs dealing with environmental control, however, it is essential that the political, administrative and technical factors which contribute to success (or failure) be identified. In erosion and sediment control programs, the evaluation results should lead to periodic updating and improvement of the program, allowing it to adjust to meet the changing needs of the soil and water conditions in the watershed.

Adequate financing for the control program is important. Sufficient funding should be provided for control of sedimentation from private and public sources, and funds should be allocated for all phases of the program, including administration, planning, operations, inspection and evaluation. Financial and technical assistance is available from several sources, at the local, state and federal levels.. For more information on finance see the Chapter on Finances.

SUMMARY

Suburban and urban sedimentation is a relatively new problem in the United States. Additional technical research is needed in several areas, such as in the field of sediment measuring techniques, developing accurate cost-benefit analyses, assessing the total impact of suburbanization on watershed hydrology, and in other important technical areas. Generally, however, technical knowledge has advanced beyond organizational knowledge. What is required now is a general understanding of how organizational forms can be developed and implemented to effectively deploy control measures. This chapter has attempted to describe some considerations involved in organizing a control program and has discussed some specific organizational structures that may be suitable, with modifications, to a variety of local situations.

The task force approach to organization outlined above represents only one pattern that may be employed in efforts to control sediment. The experiences of several communities using the task force approach, indicate that it is an attractive organizational format which helps to promote the community involvement and cooperation that is necessary for effective sedimentation control.

The ditch running along side this road was not large enough to carry the spring flow of water.

chapter three

Areawide Approaches

Erosion and sediment are twin problems which are areawide in scope. In most cases, soil erosion affects a specific geographical plot and can therefore be considered a local problem. Sediment, however, is mobile and often inflicts damage during transport and at sites far from its original source. This chapter discusses several areawide aspects of erosion and sediment, and describes some existing areawide organizational patterns that may be involved in sedimentation control.

FUNDAMENTALS OF THE AREAWIDE APPROACH

Due to the variety of this nation's physical, political, legal and demographic characteristics, no absolute definition of areawide is possible. For the purpose of this report, however, areawide may be defined as a physical area, the boundaries of which are determined by natural water drainage patterns. This definition implies no specific geographic size except that which is determined by the water drainage area. Thus, an areawide unit may or may not cross political boundaries. An areawide approach might include parts of several states, a metropolitan area, several counties, or one county.

The watershed is the basic building block of the areawide approach. This is true for several reasons, the most important being that the characteristics of a given watershed determine the direction and speed of water drainage flow. The watershed, therefore, is the basic geographical unit which determines the nature and extent of erosion and sediment problems. Soil types, topography, and the disruptive activities of man are also important determinants.

Advantages of the Areawide Approach

One of the major advantages of the areawide approach is that it promotes control over an area equal to the scope of the problem as it exists. Using the areawide approach, a control program can be tailored to the physical (drainage area) dimensions of the problem rather than to political jurisdictions.

Depending upon the scope of the problem, programs of a strictly local nature may not be capable of establishing control over all aspects of erosion and sediment. For example, local communities may spend large sums of money to dredge sediment carried to them from upstream sources, but unless upstream erosion is controlled, sediment damage may occur on a permanent basis. Removing sediment should not be interpreted as controlling sediment damage.

The basic advantage of the areawide approach is that, in many cases, it results in more effective control over the total erosion and sediment problem. The areawide approach offers several additional advantages, briefly described as follows.

Economic efficiency. Although little research had been done on the economics of erosion and sediment, it is feasible to expect that areawide control programs may result in significant savings. Overlapping operations may be avoided, and, in some cases, the areawide approach provides an opportunity for cost-sharing. In addition, federal assistance is often geared to areawide programs.

Uniform operational procedures The areawide approach can make it possible to apply uniform operational controls to on-site sediment-producing activities within a large area. This should enhance overall sedimentation control effectiveness by ensuring that the benefits derived from the use of proper operations in one area will not be offset by inadequately protected activities in another area. In addition, consistency in the application of operational control mechanisms will make it easier to judge the effectiveness of specific control measures.

Administrative efficiency. Under the areawide approach, uniform administrative procedures can be developed which will help to avoid overlapping administrative functions. Responsibilities for carrying out various aspects of the control program, such as planning, inspection and maintenance, and others, can be systematically assigned. This approach will simplify the task of developing a central source of information (research and development results, reports, etc.) on the sedimentation problems in the area, which is likely to promote a better understanding of the erosion and sediment control program, and on the adjustments needed to achieve more effective control.

Planning. Planning for control on an areawide basis is preferred over fragmented planning. Fragmented planning cannot accommodate the interrelated nature of watersheds and is likely to omit problems of erosion and sediment having their source outside the planning area. Areawide planning is more comprehensive and therefore, is likely to lead to more effective control.

Disadvantages of the Areawide Approach

Accountability. The question of fiscal and political accountability is usually considered when areawide agencies are assigned functions which affect local communities. Experience has shown, however, that this problem is surmountable, and accountability can be maintained as long as a spirit of multi-jurisdictional cooperation exists.

Developing Areawide Information *SANTA CLARA COUNTY, CALIFORNIA*

In 1950, Santa Clara County was an agriculturally oriented community of 291,000. Today it is an urban complex of over one million. Local planners estimate that the population will increase another one million by 1990.

The county is located within Santa Clara Valley which is bordered on the west by the Santa Cruz Mountains and on the east by the Black Mountains. The increasing population has pushed and continues to push residential development up from the valley floor into the hilly and mountainous areas. Development, however, has fostered several environmental problems including hillside erosion.

A major step toward controlling this problem, and thereby protecting watersheds and natural water courses, was the preparation and publication of a "Hillside Development Guide"–a manual on soil and water conservation problems associated with building on hilly terrain of the county. Detailed guidelines are given on the needs of domestic and fire-control water supplies, building foundation stability, sewage disposal, and erosion hazards as related to soil resources.

The guide brought together information and recommendations from various governmental agencies including Santa Clara County Departments of Planning, Health, and Public Works; County Fire Marshal; Cooperative Extension Service; Soil Conservation Service; California Division of Forestry; and planning departments of the cities of San Jose, Saratoga, and Palo Alto.

Nonagricultural and engineering interpretations of soils are based on criteria developed through the cooperation of the county's soil conservation district with representatives of private engineering, planning, and landscape architectural firms.

As a result of this joint effort, consultants now view the soil conservation district as an associate and cooperator rather than a potential competitor in planning, engineering, and landscaping phases of hillside development.

In 1967, the California State Senate Fact Finding Committee on Local Government, included the guide in its annual report–a report distributed statewide to city and county planning officials as an example of cooperative planning and development.

Legal authority. Most areawide organizations lack the legal authority to implement programs. This is a serious obstacle when local communities do not make an effort to support acceptable areawide programs. It should be noted that any agency whether areawide or local, will need proper legal authority to participate in a control program. The Chapter on Legal Authority discusses this in more detail.

AREAWIDE ORGANIZATIONS

Areawide erosion and sediment control programs do not normally exist as autonomous operational or administrative units. Instead, erosion and sediment control programs are usually made operational by assigning specific control responsibilities to one or more areawide agencies already having similar duties. Examples of such areawide agencies might include councils of governments, flood control districts, regional or county planning commissions, conservation districts, sewer and water agencies and river basin agencies. Erosion and sediment control responsibilities, in whole, or in part, may be assigned to these agencies in accordance with their relationship to erosion and sediment problems, and in accordance with their manpower capabilities and jurisdictional authority. The following is a brief description of some areawide organizations and a discussion of how they may share erosion and sediment control responsibilities.

Special Districts

Special districts are organized entities possessing a structural form, an official name, perpetual succession, the right to sue and be sued, to enter into contracts, and obtain and dispose of property. Their officers are publicly elected or appointed by public officials. Moreover, they normally have considerable fiscal and administrative independence from general purpose governments.

The legal authority of special districts to build, acquire, and operate works of improvement for controlling surface runoff and sedimentation may be provided for in some state constitutions containing provisions enabling their creation. Such provisions normally are not self executing and further legislation is necessary before a district is created.

While special districts can be a useful tool for providing services, they usually have drawbacks. Two major drawbacks are:

(1) A lack of mandatory coordination with other governmental programs and activities.

(2) A tendency to perpetuate themselves after they have provided a service that is not handled by an existing government.

A type of special district which avoids these drawbacks is the dependent district. In California, flood control districts are illustrative. These districts have provided leadership in coordinating the activities of local agencies with the federal government in connection with the flood control program of the U.S. Army Corps of Engineers and the Soil Conservation Service of the U.S. Department of Agriculture; and in coordinating district activities with state, county, city, and private agencies in so far as storm drain bond issues and flood control programs are concerned.

Generally, flood control districts are concerned with overall water management in relation to flood water control, water supply, water distribution (water pipelines, etc.) and water usage. In fulfilling these responsibilities, flood control districts may perform one or more of the following activities: water drainage planning; drainage policy coordination; financing drainage systems; and the construction, operation and maintenance of drainage facilities. In addition, flood control districts may conduct research related to present and future water supplies and needs.

Sanitation districts and drainage districts are also concerned with sediment. Sewage pollution is interrelated with sediment pollution because sediment interferes with sewage flow by filling sewer drainage channels. In metropolitan centers having combined sewer systems, storm water runoff frequently overburdens sewage treatment facilities, causing untreated wastes to be discharged into rivers.

Sanitation agencies may have responsibilities over a wide range of functional areas, including operation and maintenance of water drainage systems, sewage treatment and disposal, and drainage system planning. Sanitation agencies may be funded by either government support, taxing authority, or by user charges.

In the many areas of the country where sanitary districts are distinct from water drainage systems, drainage district agencies have the responsibility for drainage management and control. These districts may also play an important role in the sediment control program. Another type of special district, the irrigation district, is concerned with erosion and sediment and may also contribute significantly to sedimentation control programs.

One type of special district that is particularly concerned with sedimentation control is the conservation district (variously know as soil conservation, soil and water conservation, natural resources, and natural resources conservation districts). Over 3,000 of these districts have been created under the provisions of state law, and they include most of the land in the nation. Most conservation districts have boundaries coterminous with those of counties, and many are organically related to county governments, either by law or cooperative agreement.

Conservation district powers vary from state, to state. Among other duties, they may be charged specifically with the following responsibilities: controlling and preventing soil erosion; conserving and developing water resources; assisting in the control of floods; preventing impairment of dams, reservoirs, and navigation channels; and in general, helping to protect, conserve, and develop natural resources.

Traditionally, conservation districts have been concerned primarily with serving agricultural areas in preventing deterioration of croplands improving timber, wildlife, and water resources in rural areas. Over the years, however, conservation districts have expanded their programs to offer assistance in solving suburban soil and water problems as well. New state legislation in many states specifically provides for such assistance and gives representation to urban areas on district governing boards.

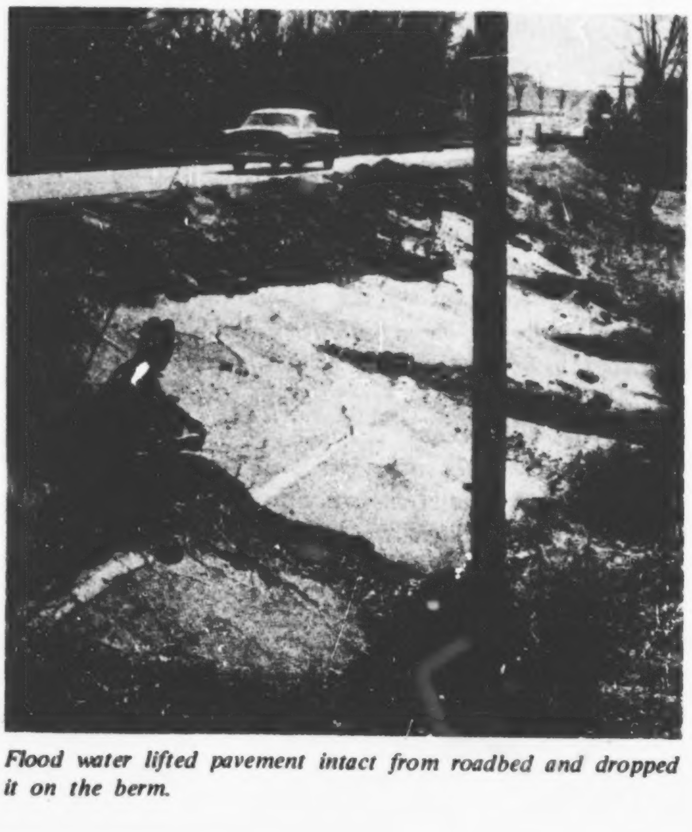
Many of the operational techniques for controlling agricultural erosion have been successfully applied to suburban and urban soil erosion problems. Memorandums of agreement between conservation districts and other federal, state and local agencies permit the district to offer a wide range of technical and other services to the area within its boundaries. Districts can also coordinate their activities with programs in neighboring areas to achieve comprehensive treatment of various resource problems.

Areawide Planning Agencies

The recent growth in the number of planning bodies, both local and areawide, is a testament to the value of planning and its increased acceptance by communities throughout the nation. Areawide planning agencies can play an important part in sedimentation control by conducting technical research, and by promoting areawide coordination of sediment control efforts.

Councils of governments (voluntary agencies composed of local governments) are becoming more involved as agents of coordination for sedimentation control in metropolitan areas. The Metropolitan Washington Council of Governments, for example, has organized a Regional Sediment Control Advisory Committee which is active in researching the sediment control activities and needs in the Washington, D.C. metropolitan area. The St. Louis Area Council of Governments has received assistance from the Department of Housing and Urban Development (HUD) to conduct a series of soil surveys to determine what kind of erosion and sediment control measures might be most useful in that area.

Areawide planning agencies may also be assigned responsibility for carrying out public education programs, and may also help to coordinate intergovernmental activities related to areawide erosion and sediment problems. For example, councils of governments might serve as a forum for the task force approach described in the Chapter on Organization. In addition, areawide planning agencies often maintain technical personnel qualified to conduct erosion and sediment research.



Flood water lifted pavement intact from roadbed and dropped it on the berm.

UNITS OF LOCAL GENERAL PURPOSE GOVERNMENTS

Most sedimentation problems are areawide (i.e., involving entire watersheds) in scope. Because their jurisdiction is normally areawide and because they possess a "middle range" of administrative capabilities, county government may prove to be the level of government best suited to provide the leadership needed in sedimentation control programs.

Elected county officials can take the initiative in establishing sedimentation control by calling for a task force of representatives from appropriate county agencies, other concerned public agencies operating within the county, private industry, conservation groups, and landowners, to develop recommendations for an areawide sedimentation control program; by making sedimentation control a stated county policy; and by soliciting the voluntary cooperation of the building industry. County department heads can help to implement sedimentation control by developing administrative policies and procedures designed to accommodate recommendations of the task force. Briefly stated, local officials can best aid the development of an effective control program by becoming personally involved, and by giving guidance and support to other groups and agencies engaged in sedimentation control.

Developing Areawide Drainage Control

MONROE COUNTY, NEW YORK

Monroe County consists of a 660 square mile area in northcentral New York, bordering on Lake Ontario. Much of the land in Monroe County remains in agricultural use, but suburban development is spreading at a rapid rate from Rochester, the area's major city.

Monroe County lies in the Great Lakes Plains, where the topography consists of rolling terrain interspersed with hills and some steep slopes. Soils in the area are generally erodible, and under the stresses of suburban growth, thousands of tons of soil have been washed into local streams.

Both erosion and sediment have presented problems in the Rochester metropolitan area. Erosion has been extensive, and, in some areas, expensive homes are threatened by erosion of supportive soils. A local conservationist estimated that erosion problems in one community will cost from ½ - 2½ million dollars to correct.

Sediment, too, has caused serious damage. Sediment from subdivision construction has deposited in many of the local streams, and each year the Corps of Engineers dredges an estimated 235,000 cubic yards of sediment from the Genessee River which flows through the county, emptying into Lake Ontario.

Erodible soils, intensive development, high sediment yields, and the fact that significant portions of the county are susceptible to flooding hazards, have made it necessary for the area to carefully plan its future drainage systems. Due to the decentralized nature of local government in New York State, however, areawide planning has been difficult.

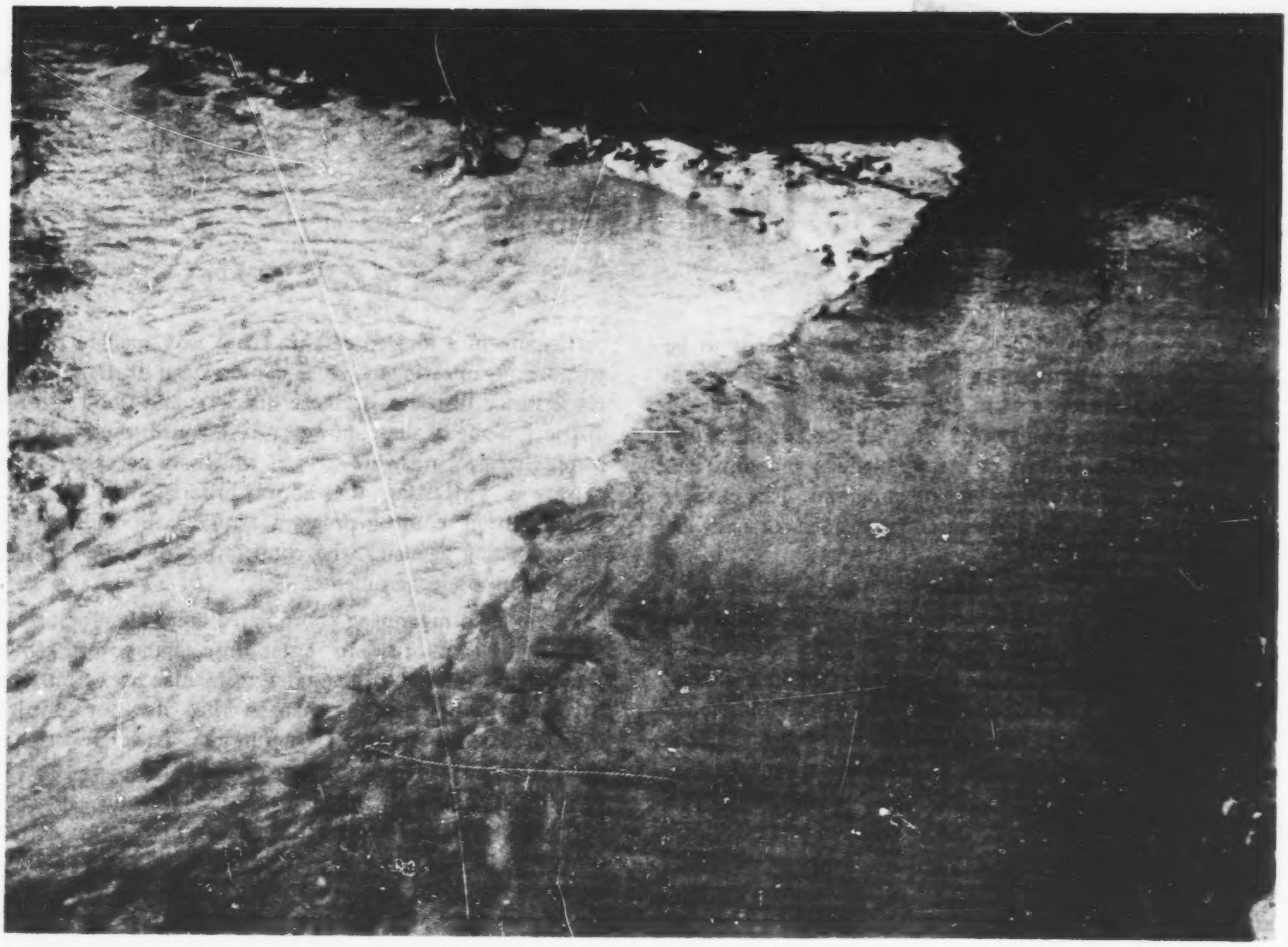
Like other New York State Counties, Monroe County is divided into several independent towns. Areawide planning is difficult because each of the County's nineteen towns conducts its own planning and zoning program. Despite this decentralization, however, areawide erosion and sediment control is being advanced by several important coordinated activities between the county and the towns.

An example of this areawide activity is the current effort to develop a regional storm drainage system that would institute uniform drainage requirements in subdivisions in all towns within the county. This ordinance, entitled the Monroe County Storm Drainage Control Law, *would help to blend town drainage formats with an areawide program of drainage control. One section of the proposed law requires subdivision developers to include plans for controlling flood hazards, which are defined as "the threat of flood damage to lands, structures and their contents by virtue of over-flow water, inundation, soil erosion and deposition of silt, urban development occupation of known or potential flood plains." This law also contains review procedures which permits the County Department of Public Works to review subdivison plans to ensure that proper drainage is planned for and implemented.*

Recognizing the need to closely coordinate the provisions of this law with other activities, Section III of the law, in part, states:

> *It is intended that these purposes be carried out in accordance with applicable Common Law Rules of Drainage and such rules, regulations and technical criteria as will be prescribed. It is also intended that these purposes be integrated with all federal, state, county and local public works, conservation measures, pollution control measures, watershed management measures and proposed urban developments not inconsistent with the primary purposes of this law.*

Flooding and erosion have been and continue to be serious problems in the Monroe County area. Both these problems, however, are being approached on a realistic basis. The proposed drainage law represents an economical and practical method of achieving areawide drainage control. In addition, most of the towns in the county are achieving more effective erosion control by guiding their respective planning and zoning programs according to a soils study completed several years ago.



Soil erosion can pollute water downstream.

RIVER BASIN AGENCIES

Through a combination of state and federal efforts, river basin authorities or commissions have been organized in many of the nation's river basin areas. River basin authorities are created by state legislatures, or, in cases where more than one state is involved, by federal-state and inter-state agreement.

River basin authorities may be authorized to accept grants and loans from the federal government, issue revenue bonds, charge fees for their services, and acquire land. However, these general powers granted to basin authorities vary considerably throughout the country.

The river basin approach is distinct from the areawide approach in that it represents a larger geographic scope. River basin authorities operate on a regional rather than on an areawide or local scale, and, generally, have the capacity to conduct basin-wide research and analysis, which is helpful in identifying erosion and sediment problems which affect entire river basins. In addition, river basin authorities may assist in developing a unified approach

SUMMARY

This chapter has attempted to explain how soil erosion and sediment control programs can be developed on an areawide basis. Several kinds of areawide organizations are described and their relationship to erosion and sediment control is discussed.

The areawide approach to overall soil and water management promises effective control in most cases because technical measures and research can be uniformly applied where needed, which, in turn, may result in economic efficiency as well. On the other hand, the areawide approach is characterized by a lack of experience with the political, legal, and administrative forms which are necessary in order that available technical knowledge can be effectively applied to sedimentation problems.

Because they often constitute the jurisdictional level most consistent with watershed drainage systems, county governments represent a logical administrative level which can develop and coordinate comprehensive sedimentation control programs.

chapter four

Legal Authority

Any program designed to serve the public needs to be rooted in law. Without a legal foundation, program effectiveness is merely a word and program accomplishment is only an illusion. This is true whether one is considering health, education, welfare or a state highway program. It is also true of sedimentation control programs. This chapter attempts to explain the legal authority needed for areawide sedimentation control.

Legal authority for controlling soil erosion and sediment is made available to local government by state legislatures, i.e., state enabling legislation, in the form of either a specific grant of power or a delegated state-wide general power. The type and extent of enabling legislation needed for sedimentation control can be evaluated by weighing certain basic considerations, namely: what are the community's existing general powers; what authority is needed to organize for areawide sedimentation control; what type of financial arrangement for the program would be equitable in terms of allocation of costs; and what legal and administrative controls are available for needed enforcement of the program.

AUTHORITY NEEDED TO ORGANIZE

The appropriate organizational structure for sediment control depends on the nature of the local sediment problem, the existing structure and capabilities of local government, and the activities of other levels of government. Since these factors vary among states, there is no one model organization which may be adapted by all areas. However, in determining an effective organizational structure the following criteria should be considered:

(1) Authority to plan effectively all the physically related parts of a drainage or subdrainage area;

(2) Acceptance of responsibility for providing needed structural and vegetative sedimentation control measures throughout the drainage area being served;

(3) Authority to finance the application and maintenance of sedimentation control measures economically;

(4) Authority to adopt legal and administrative regulations to control development and construction activities;

(5) Responsiveness to public control through the democratic process.

Several entities have evolved at the local level which may participate in a local program. These may include special purpose organizations such as conservation districts, water conservancy districts, drainage districts, and flood control districts. None of these, however, is designed to provide the comprehensive, areawide services which are necessary for a program fulfilling the above criteria. An areawide sedimentation control program requires, in addition to these existing agencies, the cooperation of units of local general purpose governments.

Essential to organizing coordinated areawide programs is the legal authority to enter into intergovernmental agreements. Intergovernmental agreements can be entered into with procedural changes that do not involve modifications in the structure or basic functional responsibilities of the cooperating agencies. Intergovernmental agreements are possible through informal understandings; through formal joint action pursuant to the general authority of the cooperating jurisdictions or to specific statutory and charter provisions; or by binding legal arangements based on formal agreements or contracts.

Intergovernmental agreements may be viewed as being applicable to two types of intergovernmental relationships:

(1) interlocal or horizontal relationships among units of local government;

(2) the vertical interaction among various levels of government.

With authority to enter into intergovernmental agreements for both horizontal and vertical intergovernmental cooperation, local government can take the initiative in creating sedimentation control programs. Many counties presently implementing sedimentation control programs have employed a task force approach, utilizing several existing agencies, including those mentioned above, rather than placing all responsibility in a new and specially created department or agency. Such coordinated efforts may be achieved through memorandums of understanding that serve to gain cooperation among county agencies (e.g., departments of public works and planning) and other concerned local, state, and federal government agencies operating within the county.

Authority should also be available to enter into informal and formal agreements with incorporated areas of the county. Authority to contract or sign memorandums designating the county as the responsible agency for review and approval of conservation plans and on-site inspections in municipalities is a power which may be essential to coordinated county-wide sedimentation control.

Where watersheds incorporate more than one county, total watershed control can be achieved with a multi-county approach. With authorization to enter into agreements with other counties (as well as with other concerned public agencies), counties strengthen their position for securing available state and federal assistance, much of which is geared for local programs of an areawide nature. An example of a multi-county watershed project is the Sugar Creek Watershed project involving Mecklenburg County, North Carolina and Lancaster and York Counties, South Carolina. These counties and their respective soil and water conservation districts have submitted, as the local sponsoring organizations, an application to the Department of Agriculture for assistance under the *Watershed Protection and Flood Prevention Act* of 1954 (P.L. 566). Upon approval for assistance, the local sponsoring organizations must prepare a watershed work plan, setting forth the responsibilities of each organization for carrying out the project, which must be agreed to by all the local sponsoring organizations and the Secretary of Agriculture (through the Soil Conservation Service) or the Congress. (For further information on P.L. 566 assistance and other assistance programs, see the Chapter on Finance.)

FINANCING PROGRAMS

The costs to local government for financing sedimentation control become significant when a control program is premised on control or treatment of an entire watershed drainage area(s). Although the costs for applying sedimentation control measures at development and construction sites is normally assumed by the developer as a part of the total project cost, comprehensive watershed or areawide programs may also require off-site structural improvements and open space acquisitions and their maintenance. Financing off-site sediment control measures is a local government responsibility. Unreasonable legal limitations can severely constrain local government's ability to meet its financial responsibilities. However, many of these limitations can be overcome by the legislative process.

In some states, for example, the incurrence of debt through bonding arrangements requires a referendum vote of all electors or property holding electors. The Advisory Commission on Intergovernmental Relations opposes referendums of this kind, advocating, instead, the vesting of legal authorization in local units of government to issue bonds subject only to a referendum initiated by a petition of voters. If a petition signed by a sufficient number of voters forces a vote, the Commission recommends that a simple majority be required to pass the bond issue.

General Obligation Bonds

These bonds are secured by the full faith and credit of the community and a pledge of its taxing power rather than by a special fund and therefore carry a relatively low risk expense. They are also exempted from federal income taxes

MEMORANDUM OF UNDERSTANDING

between the

Bucks County Soil and Water Conservation District

and the

Bucks County Planning Commission

Introduction

The Bucks County Soil and Water Conservation District, hereafter referred to as the District, has been established and organized pursuant to the Pennsylvania Soil and Water Conservation District Act of 1945 as amended. Under this Act the Commonwealth has established Districts for the purpose of conserving its soil resources including the prevention and control of soil erosion.

The Bucks County Planning Commission, hereafter referred to as the Commission, has been established by the Bucks County Commissioners and is now acting under the power of Act 247, effective since January 1, 1969.

Statement of Purpose

In view of the need for erosion and sediment control in the urbanizing areas of the County and the feasibility of erosion control measures, and in view of the compatible objectives and mutual interest of the District and the Commission, these two parties wish to establish a basis for cooperation and assistance and therefore hereby enter into this Memorandum of Understanding.

Within the limits of their authority and resources; the District will:

1. Review development plans submitted to it by the Commission and make recommendations for soil and water management measures to the Commission and to the developer and/or municipalities that may be involved. Such recommendations will be made within thirty days after the plans are received by the District.
2. Engage in an educational and informational program to acquaint municipalities and developers with soil and water management measures that may be applicable to their activities and familiarize these people with the program of the District.
3. Upon receiving a request from the developer, will provide technical assistance in the design and layout of soil and water management measures.

Within the limits of their authority and resources;

the Commission will:

1. Make written request to the District for assistance on those development plans that the Commission believes require soil and water management measures.
2. Provide for staff review and careful consideration of District recommendations for soil and water management, prior to approval of development plans. Where ever feasible, the District recommendations will be included as a part of the plan.
3. Assist Municipal Planning Authorities in developing subdivision regulations insofar as soil and water management measures may appear to be a desirable part of these regulations.

It is mutually agreed that:

In the event the District is unable to furnish recommendations within the 30 day period the Commission will proceed without the recommendations of the District. The Commission will notify the local municipality that the District recommendations will be forth coming at a later date.

This memorandum shall be effective when signed by both parties. It may be terminated or modified at anytime by agreement by both parties, and may be terminated by either party by giving sixty (60) days notice in writing to the other party.

on the interest provided their investors. Because of these reasons, general obligation bonds generally carry low interest rates. However, given its need for a general election, the disadvantage of this type of bonding is its unattractiveness for proposed projects not having apparent community-wide benefits. Thus a proposed sediment basin in one watershed may not be supported by the voters residing in another.

Special Assessment Bonds

These bonds are appropriate for financing improvements, e.g., storm drain facilities and debris basins that benefit specific property. They are payable from assessments levied on the properties benefited, and become a lien on such properties. They provide the benefiting property holder with the option of making payments on his assessment over a period of time or paying it all at once.

Revenue Bonds

Revenue bonds are issued to finance revenue producing projects and are payable from the revenues received from these projects. One feature of these bonds is that they are not normally subject to state constitutional or statutory debt limits. They are usually acceptable to the general public since only the users pay costs thus avoiding increases in the general tax rate. Their disadvantage compared to general obligation bonds, is a higher interest rate. However, in some states local governments have been able to offset this disadvantage by pledging to secure payments with the issuance of general obligation bonds should receipts from users' charges fall short. Revenue bonds may prove appropriate for water supply dams and reservoirs, with assessments based on water consumption rates.

Flexibility in Refunding and Refinancing

A community may wish to recall a bond issue before its maturity date to liquidate its debt or to take advantage of lower interest rates. This situation may develop where taxes or other revenue sources of the community have produced greater funds than anticipated, where market conditions affecting interest rates change favorably, or where the community's credit improves. While authorization to sell callable bonds is desirable, it should be noted that such bonds sometimes have higher legal ceilings on interest rates.

Miscellaneous Authority

Other considerations to be weighed in assessing desirable legal authority include:

(1) *Authority to obtain property by gift, purchase, or eminent domain.* In connection with eminent domain, it should be noted that many needed projects have incurred long and costly delays waiting conclusion of purchase price negotiations. This potential problem can be avoided in those states granting local governments the power of "prior right of entry" as ancillary to eminent domain. Prior right of entry authorizes entry upon the property prior to final acquisition and permits immediate construction activity. The power of eminent domain should be used as a last resort. Frequent use may cause adverse public opinion. It is advisable to plan ahead for needed open space and construction sites and to acquire the necessary land through the Federal Advance-Land Acquisition Program, or by purchase, or leasing.

(2) *Authority to acquire facilities owned by private individuals and firms.* Many development projects require temporary sedimentation control structures during construction which may also serve as permanent installations. It would be desirable for local communities to have the authority to acquire these within a reasonable time after a development project is completed in order to ensure their maintenance. A formal procedure may be needed to facilitate equitable purchase prices.

(3) *Authority to accept grants.*

LEGAL CONTROLS

Federal

Water quality maintenance, through the construction of sewage systems and waste-treatment works, has traditionally been a responsibility of local government. The federal government became significantly involved when, in 1956, Congress enacted the *Federal Water Pollution Control Act,* which defined the role in enforcing abatement of pollution of interstate waters. The Act was amended in 1961 to further strengthen its enforcement procedures and extend federal jurisdiction to abate both interstate and intrastate pollution of interstate or navigable waters. *The Water Quality Act* of 1965 left intact these enforcement procedures while adding a new major enforcement provision. Under this provision all states were required to enact water quality standards for their interstate waters by June 30, 1967 (subject to review and approval of the Secretary of the Interior), or by default have the standards established by the federal government. The state standards must "enhance the quality" of waters, and be accompanied by a plan for their implementation and enforcement.

All the states have complied with the June 30, 1967 deadline (however, as of January, 1970, 23 approved states' standards included unresolved exceptions). Moreover, by fiscal 1970, 40 states also adopted comparable standards for their intrastate waters and others have stated an intention to do so.

Federal and state water quality standards declare that turbidity is a pollutant where it interferes with the beneficial uses of water. Since a major contributor to turbidity is sediment, it is expected that all the states will declare sediment a pollutant where it interferes with the beneficial uses of any state waters. Maryland and Wisconsin have, in fact, already done so.

In addition, *Executive Order 11258*, issued in 1966, through authority of the *Water Quality Act* requires all federal departments to review federal and federally aided operations as to any significant potential for abatement of water pollution by sediment. The respective departments may prescribe remedial measures as necessary. The Order should be of particular significance in terms of sediment reduction in connection with urban and surburban highway construction.

State Control

State water pollution control legislation developed traditionally out of the authority of state health departments to preserve public health. In conjunction with this, there was a piecemeal lodging of concurrent water pollution control authority in several other departments of state governments such as those dealing with agriculture, fish and wildlife, and mines and minerals which also had an interest in water pollution control aside from public health considerations. The modern approach to the problem is reflected in recent state statutes whose objective is to preserve and improve water quality for all legitimate uses and do this through a board that represents all affected interests in the state. Accompanying this has been a shifting emphasis from the mere abatement of existing pollution to the policy of preventing pollution in its incipiency.

In the early statutes, the administrative approach was largely negative in character. That is, when a particular action was found to cause pollution, the administrative agency was authorized to take steps to abate such pollution. A *Suggested State Water Pollution Control Act* prepared by the Federal Water Pollution Control Administration (FWPCA), follows the more recent statutes by authorizing a board which represents all affected interests in the state to develop a comprehensive program to deal with the problem in all waters of the state. Under this approach, the board, having determined permissive limits of waste discharges into the waters of the state, uses its enforcement procedure to abate existing pollution and restore the quality of polluted waters, while through a system of permits it prevents any increase in waste discharges which would impair desired water uses.

The Act is designed to give the board discretion in administration of the program and makes its jurisdiction complete over all waters of the state. It avoids such exemptive practices as excluding particular industries or geographic areas, and legislative classification of particular streams for specified water uses.

Water quality standards. Under the provisions of the *Water Quality Act*, federally approved state standards (which may be expressed in terms of treatment requirements; or in terms of volume, strength or kinds of waste discharges) may be applied either to interstate waters or to the source of pollutant discharge. While states have jurisdiction to develop standards in both these areas (the pollution source and interstate waters), the federal government has authority to review and approve standards with regard only to interstate waters. However, control over the quality of interstate waters allows the FWPCA to directly effect the quality of pollutant discharges, when such discharges cause the quality of interstate waters to be below federally approved standards.

The *Suggested State Water Pollution Control Act* gives state agencies permissive authority to fix standards of water quality such as to protect the public health and welfare and the present and prospective future use of state waters for all legitimate purposes. Standard setting on a case-by-case basis is thus made possible. Standards once promulgated have a definite legal effect and their violation is made unlawful. Their adoption must be preceded by a public hearing conducted by the state board, for which due notice must be given.

Except in four states (Florida, Minnesota, Montana, and Washington), existing state standards relating to turbidity, silt, and sediment are nonquantitative and narrative in form.[1] They are generally based upon a criterion that prohibits deposits that would interfere with the assigned use of the water. For example, Colorado standards state that Colorado water shall be:

> Free from substances attributable to municipal or industrial wastes, or other controllable sources that will either settle to form unsightly, putrescent, or odorous bottom deposits or will interfere with the classified use of the water.

Should Colorado waters receive sediment deposits interferring with the designated use of those waters, the state, presumably, is authorized to enforce abatement of such deposits. Since the sediment sources in most cases are extremely difficult to trace, abatement appears to be most feasible through the use of areawide preventative programs involving comprehensive planning and enforcement rather than through a piecemeal, after-the-fact, approach.

In setting a course of action for local officials, it should be noted that much can be contributed in the area of research. Research determining the natural or reasonable level of turbidity and sediment for all local waterways is especially needed for the purpose of establishing criteria that determine acceptable limits of sediment transport from future development projects. Such information, combined with appropriate inspections of waterways adjacent to development projects, could provide more objectivity for determining legal liability, and thereby, serve as the basis for meaningful state water quality standards.

A permit system, such as that contained in the *Suggested State Water Pollution Control Act*, might require local development activities to be preceded by an examination of development and construction plans, specifications, and other data, before any wastes stemming from such activities are discharged in any waters of the state. This would allow the state control agency to prohibit sedimentation altogether or to grant conditional approval on the basis of natural sediment and turbidity levels and the existing levels before construction.

Enforcement. A variety of enforcement methods is provided by the suggested Act. One method makes it unlawful to cause any pollution of the waters of the state or to violate any order issued by the water pollution control agency, including an order establishing a classification of waters or standards of water quality. Pollution of waters of the state is declared to be a public nuisance and is, therefore, subject to abatement in accordance with the state's practice of abatement of nuisances.

Violation of provisions of the Act of any order or determination by the control agency, or failure to perform any duty imposed by the Act, is declared to be a misdemeanor. In addition, the state attorney general has the duty to bring an action for an injunction against any

An Example of State Legislative Action – Maryland Excerpts from House Bill No. 509

Section 105

The General Assemly of the State of Maryland hereby determines and finds that the lands and waters comprising the watersheds of the State are great natural assets and resources; that as a result of erosion and sediment deposition on lands and waters within the watersheds of the State, said waters are being polluted and despoiled to such a degree that fish, marine life, and recreational use of the waters are being adversely affected and curtailed.

Section 106

a.) Before land is cleared, graded, transported, or otherwise disturbed for purposes including, but not limited to the construction of buildings, the mining of minerals, the development of golf courses, and the construction of roads and streets by any person, partnership, corporation, municipal corporation or State agencies within the State of Maryland, the proposed earth change shall first be submitted to and approved by the appropriate soil conservation district. Land clearing, soil movement and construction shall be carried out in accordance with the written recommendations of the said soil conservation district regarding the control of erosion and siltation. . . .

c.) The Department of Natural Resources shall assist the soil conservation districts in the preparation of a unified sediment control program and in the implementation of said program pursuant to this subtitle. Furthermore nothing in this subtitle shall affect the responsibilities of the Department of Water Resources under Article 96A of the Annotated Code of Maryland (1964 Replacement Volume and 1969 Supplement).

d.) Notwithstanding the provisions of this Section, the Department of Natural Resources, shall review and approve all land clearing, soil movement and construction activity undertaken by any agency of State government.

Section 107

The provisions of this subheading shall not apply to agricultural land management practices, the construction of agricultural structures or to the construction of single-family residences and/or their accessory buildings on lots of two acres or more. Regardless of planning, zoning or subdivision controls, no permits shall be issued by any county for grading or for the construction of any building, other than those exempted above, unless such grading or construction is in accordance with plans approved as provided in this subheading.

Section 108

a.) Each of the counties shall have the power and authority to issue grading and building permits. No county shall issue a grading or building permit under the provisions of Section 106 until the developer submits a plan of development approved by the appropriate soil conservation district, and after certification by the developer that any land clearing, construction or development will be done pursuant to said plan. Criteria, for referral of an applicant for a grading or building permit to the appropriate soil conservation district, which have been developed by a county shall be acceptable to the responsible county agency or agencies, the soil conservation district and the Department of Natural Resources. The County agency responsible for on-site inspection and enforcement of the provisions of this subheading shall make a final inspection and forward its report to the appropriate soil conservation district. Notice of violation of the provisions of this subtitle shall be filed with the Department of Natural Resources, as well as with the appropriate county agency.

b.) Each county shall develop grading and building ordinances, or portions therof, which are necessary to carry out the provisions of this subtitle. The Department of Natural Resources and appropriate soil conservation district shall assist the several counties in the development of such ordinances or necessary portions therof. The provisions of this subsection shall be carried out prior to March 1, 1971. Prior to March 1, 1971, established ordinances and procedures shall be used by the counties to carry out the provisions of this subtitle.

Section 109

Any violation of this subheading shall be deemed a misdemeanor, and the person, partnership, or corporation who is found guilty of such violation shall be subject to a fine not exceeding five thousand ($5,000.00) or one year's imprisonment for each and every violation. Any agency whose approval is required under this subheading or any person in interest may seek an injunction against any person, partnership, or corporation, whether public or private, violating or threatening violation of any provisions of this subheading.

Section 110

The Department of Natural Resources is empowered to promulgate regulations for the unified administration and enforcement of this subtitle.

person violating any provision of the Act or any order of the agency.

Administrative action is the principal method of making the program effective. The agency is empowered to issue orders against alleged pollutors after adequate opportunity for hearing. Such orders, if not appealed to the court, become final and are enforceable in much the same way as the judgement of the court. The same administrative hearing procedure is employed in the case of revocation, denials, or modifications of permits.

State water pollution control agencies. The authority for control activity among our states is vested in three general categories:

(1) State health agencies–20 states;
(2) A specific agency created by statute and placed organizationally within the state health agency–10 states;
(3) Independent agencies, established outside the state health department–20 states.

(A list of addresses for these agencies can be found in the appendix.)

Definition of pollution. The most important definition in the suggested Act is that of pollution. It is designed to protect all legitimate uses of water in the state. To this end, pollution as defined includes both discharges of wastes actually or potentially harmful to such uses, and also the altering of the properties of the water in such a way as to be harmful, including changes in turbidity.

This definition must be read with subsequent sections of the Act authorizing the setting of water quality standards. Discharges which are consistent with such standards are not considered pollution for purposes of the Act.

The suggested Act, therefore, gives immediate legal effect to the agency's action on classifying waters and setting standards, without requiring the agency to hold its enforcement powers in abeyance until such action can be completed.

Local Control

As state standards relating to sediment pollution are established, local governments will have an idea of what is required of them in order to upgrade or maintain the quality of interstate waters in their respective states. In effect, all local jurisdictions will be placed in the position of adopting local standards equal to their respective state standards, or have them imposed by state authority. Therefore, in order to be prepared to meet the expected development of more rigorous state standards, and thereby avoid the possibility of forfeiting the right to control land-use activities within their boundaries, local governments should begin to develop sound land-use regulations to prevent sediment from entering their waterways.

Control over public improvements. Accelerated erosion and sediment can result as much from public development and construction projects as it can from private ones. Local officials should not expect cooperation forthcoming from the private sector (developers, contractors, and landowners) to control erosion and sediment when control is lacking over government activities. Moreover, local government can be held liable for sediment damages (steming from public properties) suffered by private landowners. In a summary of the judicial interpretations of this legal aspect, the Committee on Condemnation and Condemnation Procedure of the American Bar Association has stated:

> If the constitution of the State in which the (damaged) property was located provided for the payment of compensation only if property had been taken for a public purpose, the courts awarded compensation to the owner if the damages were substantial enough to amount to a taking. In the States where an owner had to be compensated if his property had either been taken or damaged for a public use, the courts only had to find that there had been some damaging in order to award him compensation.

County officials can begin providing the needed leadership to effect sedimentation control in their communities by working to make erosion and sediment control a stated policy of all public agencies operating within their jurisdictions. For example, park and road agencies should incorporate erosion control techniques in the design and maintenance, as well as applying them during the construction period, of their projects. (In the long run, these efforts will result in lower maintenance cost).

When a local government contracting agency enters into an agreement with a private contractor for construction of public improvements, provisions for sedimentation control should be included in the contract. These provisions should recognize the importance of adhering to the sedimentation control principles outlined in the Chapter on Implementation and Control. The contract agreement should be entered into only after the appropriate county agency or agencies have reviewed and approved the type, extent, and time of application of needed erosion and sediment control measures specified in the contractor's proposed project plan.

Control over private development and construction. In broad terms, local controls over private development and construction activities include:

(1) Control over sewer use;
(2) Control of water pollutants:
(3) Control over land uses hazardous to the general health and welfare;
(4) Control over construction practices harmful to the general health and welfare.

These controls can be designed both to regulate activities which adversely affect water and related land resources, and to provide orderly community development. Local controls are normally implemented through one of the following types of ordinances, codes, regulations or administrative

Sedimentation Control Ordinance *MONTGOMERY COUNTY, MARYLAND*

In the Spring, 1965, a sediment control task force, formerly appointed by the Montgomery County Council, completed development of a proposed sedimentation control program for the county. The Council subsequently made the program stated county policy and solicited the voluntary cooperation of the building industry. Two years later (6/27/67), the council made sedimentation control mandatory through adoption of an amendment to the county's subdivision regulations, Chapter 104, as codified in the Montgomery County Code. This amendment, which represents the county's sedimentation control ordinance, follows:

Amend Sec. 104-24 Preliminary Subdivision Plan – Approval Procedure by adding new subsection (i) as follows:

(i) Sediment Control. *The approval of all preliminary plans and extensions of previously approved plans shall include provisions for erosion and sediment control, in accordance with the Montgomery County Sediment Program, adopted by the County Council June 29, 1965.*

- *(1) The Board, in its consideration of each preliminary plan or extension of previously approved plan shall condition its approval upon the execution by the subdivider of erosion and sediment control measures to be specified by the Board after receiving recommendations from the Montgomery Soil Conservation District.*
- *(2) One copy of each approved preliminary plan or extension of previously approved plan shall be referred to the Montgomery Soil Conservation District for review and recommendation as to adequate erosion and sediment control measures to prevent damage to other properties.*
- *(3) The installation and maintenance of the specified erosion and sediment control measures shall be accomplished in accordance with standards and specifications on file with the Montgomery Soil Conservation District.*
- *(4) Permits for clearing and grading prior to the recordation of plats shall be obtained from the Department of Public Works subject to the granting of temporary easements and other conditions deemed necessary by the Department in order to inspect and enforce the performance of the specified erosion and sediment control measures provided for in sub-section (1) above.*
- *(5) In the event the subdivider proceeds to clear and grade prior to recording of plats without satisfying the conditions specified under Sec. 4, the Board may revoke the approval of the preliminary plan or extension of previously approved plan.*

Amend Article 1, Section 23-2 General Requirements (of subdivision plans) by the addition of a new paragraph to be known as 23-2 (1) to read as follows:

(1) Erosion and Sediment Control Measures.
Adequate control of erosion and sedimentation of both a temporary and permanent nature shall be provided during all phases of clearing, grading and construction as approved by the Director.

Amend Section 23-8, Preliminary Plats – Preparation by the addition of a new paragraph to be known as 23-8(g) to read as follows: (Preliminary plats shall include a)

(g) Statement that Erosion and Sediment control methods shall be provided prior to any clearing, grading or construction.

Amend Article 2 of Chapter 23 by the addition of a new paragraph to Section 23-12. Final Plats – Approval to be known as 23-12(c) to read as follows: (Plats shall be approved only if)

(c) Plans and specifications for the control of erosion and sedimentation, if such controls are deemed necessary, have been submitted and approved by the Director of Public Works or his agent. This approval shall be concurrent with the approval of the aforesaid plans and specifications, and become a part thereof.

rulings:

- (1) A zoning ordinance which recognizes such physical limitations as soil permeability, soil stability, topography, natural drainage, as well as existing and future man-made factors, such as reservoirs, debris basins, major highways, etc;
- (2) A subdivision control law designed to protect the public health and welfare by preventing the installation of inadequate storm sewage facilities and surface water drainage (e.g., The Los Angeles County subdivision ordinance, requires subdividers to provide drainage improvements according to documented drainage standards to reduce flooding and economic loss due to storm water within and outside of the subdivision);
- (3) A grading ordinance that includes procedures for minimizing erosion and sediment;

(4) A Flood plain ordinance that limits the extent and intensity of development;
(5) A building code with special reference to soil stability and drainage;
(6) Regulations on sewerage.

An effective approach for implementing community plans, designed with environmental conservation in mind, is to make adequate provisions for accommodating such plans in zoning ordinances. An example of this type of zoning control is a zoning provision calling for hillside cluster development. Cluster developments have the benefit of restricting the area of construction while building according to the existing topography. This reduces the net sediment yields normally experienced in conventional row-type development projects by allowing for adjacent vegetational downslope areas that catch sediment before it empties into relatively large channels that are difficult to control.

In addition to zoning, other legal means appropriate for controlling private development activities include subdivision, drainage, and grading ordinances. In broad terms, ordinances can require subdividers and builders to submit preliminary and tentative maps of proposed subdivisions including their physical features; have maps reviewed and approved by county officials; make street and drainage improvements; specify grading and erosion control standards provide easements; provide flood control facilities; require topographic, soils and geologic information; and require a statement or diagram showing land proposed to be devoted to residential, industrial, public or other uses, and the minimum lot sizes thereof.

Such ordinances also may require posting of performance bonds and cash escrows. This would reduce the risk of cases where the lack of public funds prevent local governments from providing immediate remedial measures to correct the incomplete or inadequate application of needed sedimentation control measures by developers or their contractors.

A good example of local legislation designed to control erosion and sediment may be found in the Fairfax County, Virginia, *Erosion Control Ordinance* of 1967. Its language is brief and written directly into the County Code by adding scope to existing regulations rather than being written as a separate, self-contained document. Developers were previously required to conform to the provisions of the code and thus must merely assume certain specific additional responsibilities.

This is how the ordinance works in Fairfax County:

(1) The department of county development will not approve plans or issue a construction permit unless a builder's plans meet ordinance requirements;
(2) Developers are required to submit a soil conservation plan which the county reviews and approves. A bond, and in some cases a cash escrow, is required to guarantee that the approved soil conservation plan will be carried out by the developers;
(3) On-site inspection by department of county development personnel evaluates compliance of developers with the approved plan;
(4) If a developer fails to comply, his escrow is used by the county to take needed emergency conservation measures. Meanwhile, the developer would be required to increase his cash escrow.

A testimony to this system is the fact that the escrow provision has not yet been invoked. The system provides a reasonable procedure, and responsible developers have found that the conservation protection called for can be provided at relatively little cost. ($50 per building lot is the current estimated cost by the Suburban Maryland Home Builders Association.)

SUMMARY

The legal basis for local control of sedimentation is state enabling law. Without this authority, local governments cannot regulate development activities to control surface water runoff and soil erosion. To ensure that local governments have the necessary powers, state legislation should allow political subdivisions to manage soil erosion and sediment in coordination with other conservation and water management programs.

Under the *Water Quality Act of 1965*, all the states were given option of preparing water quality standards for their interstate waters or possibly have the federal government do it for them. All 50 states elected to draft their own water quality standards.

As a result of federal and state standards, local governments have an idea of what is required of them in order to upgrade or maintain the quality of interstate waters in their respective states. Since sedimentation is a major source of water pollution, local jurisdictions are placed in the position of adopting local standards to control their erosion and sediment problems, or possibly forfeit the right to control land-use activities within their boundaries.

This chapter has attempted to emphasize those legal considerations that are essential if local communities are to take the initiative in establishing and enforcing local standards of erosion and sediment control.

Footnotes

1. U.S. Department of Interior, Federal Water Pollution Control Administration, "Suspended Solids," compilation of state pollution standards, in "Water Quality Standards Summary," June, 1969.

2. 1966 *Report of Committee on Condemnation and Condemnation Procedure*, David R. Levin, Chairman. Section of Local Government Law of the American Bar Association, 1966. P. p. 84.

chapter five

Planning for Sedimentation Control

Growing communities need to plan for orderly development. Such planning usually falls into the three general categories of land-use planning, transportation planning, and public facilities and utilities planning. These plans would include such activities as subdivision development, open space preservation, construction of highways, streets, parking lots, mining operations, and the construction of sewerage systems, public buildings, water supply systems, and other public facilities.

In many communities, the plans for development and construction activities have not contained provisions for controlling erosion and sediment. A major purpose of sedimentation control planning is to develop control provisions which can be introduced into plans for construction and development activities in order that sedimentation problems from these sources can be controlled. Such provisions should provide sedimentation control during development and construction as well as when facilities are completed and in use. In cases where normal operations such as mining activities, cause sedimentation problems, control is desirable during and possibly after the mining process. The purpose of this chapter is to describe the basic information needed for developing sedimentation control provisions, and to explain how these provisions can be incorporated into various levels of planning.

Soil erosion and sediment control planning consists of several basic steps, outlined as follows:

1. Determining the level at which sedimentation planning will take place.
2. Conducting watershed research.
3. Developing erosion and sediment control provisions (or a control strategy).
4. Implementing control strategy by incorporating control provisions into the plans for all activities which produce erosion and sediment, including activities which are likely to cause sedimentation in the future.
5. Following through on control provisions at the project level.
6. Conducting evaluations of the success of the control program and providing for revision and updating, as required.

LEVELS OF EROSION AND SEDIMENT CONTROL PLANNING

Like other kinds of planning activities, erosion and sediment control planning may take place at several levels and may be conducted by a number of different agencies. This chapter is primarily concerned with four levels of sedimentation control planning, all of which, in practice, are interrelated. These levels of planning may be referred to as areawide planning, community or local planning, project planning and regional planning. These planning levels are described below.

Areawide Planning

Areawide sedimentation planning is premised on geographic factors, such as watershed characteristics, instead of on strictly political boundaries. Thus, depending upon physical characteristics, areawide planning may include mutual planning efforts on the part of one or more counties (if watershed characteristics are interrelated within the area encompassed by the county or counties) or a joint planning effort by a county (or counties) and one or more municipalities.

Areawide sedimentation control planning may be conducted by a number of different agencies which have areawide planning capabilities. These might include councils of governments, flood control districts, county and multi-county planning bodies, conservation districts, sanitation agencies, watershed agencies, drainage districts and others. The erosion and sediment control planning function should be conducted by the agency or agencies best suited to the task. In practice, planning responsibilities are usually shared by several of these agencies. A method of coordinating these efforts is essential.

Local or Community Planning

Local planning refers to planning activity conducted for a specific municipality, county, or other jurisdiction, or for parts of such entities. Local planning is usually smaller in scope than is areawide palnning, and may not address the entire geographic scale of the physical problem. Local sedimentation control planning may be necessary in cases where areawide control planning is unavailable, an in instances where areawide planning does exist, local planning may be utilized as an unput into the areawide control activity.

Community level sedimentation control planning may be carried out by local agencies such as municipal planning commissions. In addition, most areawide agencies offer planning services to local communities when legal arrangements permit. Thus, planning for local control programs may be conducted by county planning commissions when the county's jurisdiction parallels the areawide problem, or by multi-county planning organizations such as councils of governments, or by conservation districts, and others.

Chapter Three has emphasized that areawide approaches, including areawide planning approaches, offer more effective control over erosion and sediment than do fragmented or isolated efforts. Local or community planning efforts should therefore be coordinated as closely as possible with areawide planning. Both areawide and community sedimentation control planning are concerned with the same substance, i.e., watershed research and the development of a sedimentation control strategy. The difference between the two is a matter of scope, not substance.

Close articulation between local and areawide planning is crucial during the period when plans are to be implemented. While the areawide planning function can be carried out by a number of areawide agencies, the implementation of such plans requires that they become an integral part of many other community plans.

Regional Planning

Regional erosion and sediment control planning refers to planning activities conducted over a large area, such as river basins, or sub-state districts. Planning at this level is being conducted in some areas by river basin authorities or commissions. River basin research helps to tie together the trends and needs of watersheds within river basins, and can yield knowledge about how river basins are affected by erosion and sediment.

Project Plans

The basic objective of sedimentation control planning is to eliminate or curtail erosion of soil and thereby reduce sediment yields. To achieve this objective, each individual activity or project which produces erosion and sediment will need to implement specific erosion control measures.

Project planning represents a method by which areawide and community planning may be implemented. For example, if community or areawide sedimentation control planning reveals that a proposed housing development site has soils that are particularly susceptible to erosion, the project plans for that development should call for appropriate erosion prevention measures, such as sediment basins, proper grading and seeding, construction of berms, and other possible technical measures. The technical apsects of project planning are described in more detail in the Chapter on Implementation and Control.

WATERSHED RESEARCH THE BASIS OF EROSION AND SEDIMENT CONTROL PLANNING

In most cases, erosion and sediment control planning will constitute only a part of overall resource planning and management. All resource conservation efforts, however, require that a solid base of data be accumulated before management strategy is developed. For areas experiencing suburban and urban development, or for those which will experience it in the future, erosion and sediment control planning should provide at least the following watershed data.

Soil survey information on the seasonal high-water table would have told developers that this location was undesirable for home-building.

Hydrologic, Soils, and Geologic Information

Hydrologic information includes such items as rainfall and runoff data; temperature changes (thaws–freezing); capacity of streams and rivers; condition and capacity of existing storm drainage systems; and sediment transport and deposition.

Soils information would include data such as soil types; soil erodibility, types of vegetative coverage; and stability of existing or proposed slopes.

Geologic information would indicate the existence of geological hazards which may be defined as any condition in earth whether naturally occurring or artificially created, which is dangerous or potentially dangerous to life or property due to movement, failure, or shifting of earth.

Developmental Information

The value of hydrologic, soils, and geologic information is that it can reveal where and to what extent erosion and sediment problems exist. To be most effective in preventing sedimentation, this information should be compared with various kinds of developmental information. In this way, it is possible to foresee what impact anticipated development will have on the soil and water relationships within watersheds, and various conservation measures can then be planned for in advance of development.

Developmental information relevant to erosion and sediment control would include the following:

(1) *Population data*—present population, anticipated growth and movement; employment and commuting patterns

(changes and trends); population density, educational needs; and other data.

(2) *Public facilities and utilities*—anticipated construction and improvement of sewer and drainage systems; schools, parks, fire and police stations, libraries, hospitals, water supply facilities, and others.

(3) *Land-use data*—including residential (present housing patterns and needs; anticipated construction—its size, location and type, and its probable effect on watershed hydrology); industrial growth and change; commercial development; and other recreational and institutional developments.

(4) *Transportation data*—includes information on present and future transportation trends, such as automobile usage; road and highway construction; airport facilities; mass transit facilities; railroad and pedestrian facilities.

THE IMPORTANCE OF PHYSICAL DATA TO DEVELOPMENTAL PLANNING

The lists cited above make reference to information of two types. The first, geologic, soils and hydrologic information, refers to the basic physical environment of man; while the second, developmental information, refers to the activities of man. The purpose of relating the two is to determine what inmpact suburban and/or urban development is likely to have on the environment, and conversely, the limitations that the environment is likely to place on development.

Soil surveys illustrate the importance of physical resource facts. For many years, conservationists and other experts have stressed the importance of soil studies to proper land-use planning. Most people are unaware of the fact that soils are characterized by a variety of strengths and weaknesses which affect their suitability for various uses. Briefly stated, different soils behave in different ways.

Using Soil Studies in Land-Use Planning

SOUTHEASTERN WISCONSIN REGION

The Southeastern Wisconsin Region consists of seven counties covering 2,689 square miles. The region is located west of Lake Michigan, and north of the Illinois – Wisconsin Border. The seven counties – Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington and Waukesha – comprise about 5 percent of the state's land area, yet as one of the fastest growing areas in the nation, it contains over 40 percent of the state's total population.

The population of the region, which is estimated currently at 1.6 million people, is growing at the rate of 33,000 persons per year and is expected to reach 2.7 million by the year 1990. A most significant demographic trend has been the swift and intensive growth of suburban communities. Between 1950 – 1963, land devoted to urban use increased by almost 150 percent. If current trends continue, over 15 square miles of land will be converted from rural to urban uses each year, and by 1990, over 400 square miles of land will have undergone this conversion.

The Southeastern Wisconsin Regional Planning Commission, the local conservation districts, planning agencies, local governments and other local groups have recognized that this type of development pattern had very important effects on the region's environmental problems, such as water supply and flooding, and water pollution.

Because of the vast amount of building underway, it was not sirprizing that a major problem of soil erosion and sediment developed. Soil characteristics vary sharply within the region and many local groups became concerned that the building boom would cause irreparable damage to land, and that development on unsuitable soils would result in serious sedimentation, flooding, and septic tank problems during and after the construction phase.

Accordingly, in 1963 the Southeastern Wisconsin Regional Planning Commission (SEWRPC), in cooperation with the Soil Conservation Service of the U.S. Department of Agriculture, initiated a two-year study designed to provide detailed soil surveys for the entire region. The study completed a project started but interrupted years before, and provides soils data on all of the region's acreage. The survey was completed in 1966, and the results are published in SEWRPC Planning Report No. 8, The Soils of Southeastern Wisconsin. *The completed survey provides such information as depth of water tables, the location and capabilities of various soil types, where soils are susceptible to swelling, shrinkage, frost action, erosion, and topographical data.*

The real significance of this data is that it has been put to use. Although the regional soil survey was originally intended for use in regional planning, it became obvious that the survey would be useful to local communities within the region. Accordingly, to help assure full use of the survey, the SEWRPC negotiated a memorandum of understanding with the U.S. Soil Conservation Service, and local agencies to help familiarize local communities with the soil survey and its uses. The survey has been well received, and as a result, much of the region's land-use planning is now conducted on the basis of soils information.

Local officials who are familiar with the project maintain that the soil survey, which costs about $0.30 per acre, was a very sound capital investment. For example, the executive director of The Southeastern Wisconsin Regional Planning Commission estimated that the soil survey will save approximately $300 million in the cost of residential land development in the region during the next 25 years. In addition, the soil survey, because it is used in planning, is helping to preserve soil and water resources.

Some types of soils slip and slide easily while others are relatively stable. Some types absorb water and septic tank seepage while others do not have this capacity. Some types of soil do not erode easily, while other types will erode under slight force.

The failure to recognize the importance of soil types during urbanization has been extremely costly. The tonnage of soil washed away from construction sites has been enormous, and the cases where septic tanks have failed because of unsuitable soils are too numerous to count. In all, many millions of dollars worth of damage is caused annually because land-use planning at the local level has not been related to soil capabilities.

New methods of incorporating soils data into maps are being used by a growing number of planning agencies throughout the country. Such soil maps can indicate which soils are suitable for various types of uses, such as recreation areas, highways, homebuilding, open spaces, septic tanks, etc.

Soil studies are of little use unless they are made part of the overall planning function; knowledge of local soils should precede plans for disturbing the soil or building on it. Accordingly, all agencies involved in water and land-use planning should possess the capability of conducting comprehensive soil studies, or if they do not, they should obtain this capability through agreements with agencies having the trained manpower, or through professional consultants.

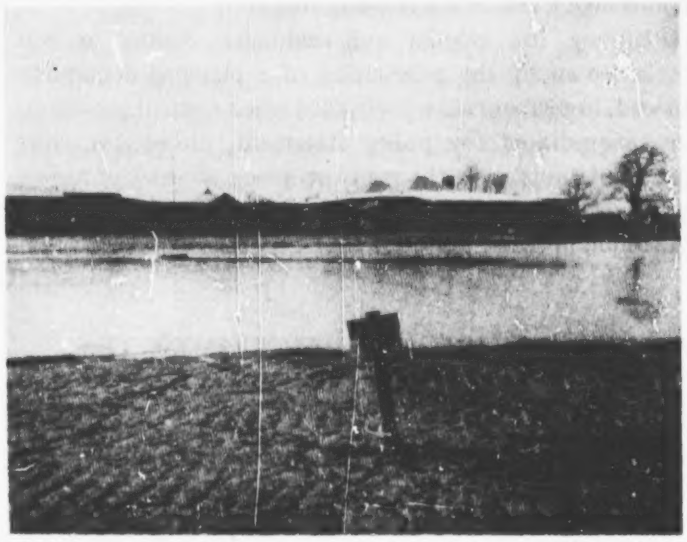
PLANNING A SEDIMENT CONTROL STRATEGY

The purpose of conducting research and collecting watershed data is to formulate a strategy, based on facts, for controlling erosion and sediment. (It is important to remember that watershed research is useful to for comprehensive conservation planning and it is not used exclusively for erosion and sediment control.) Once hydrologic, soils, and geologic data is available, it needs to be analyzed in connection with the patterns of suburban and urban development taking place.

When these two types of information are brought together for analysis, some general outlines for developing sedimentation control measures should become apparent. For example, when soil types within a rapidly growing area are found to highly erodible, the land-use plans for that area should take into account the potential danger of erosion and provide for appropriate precautionary measures for any activities permitted in that area.

IMPLEMENTATION OF PLANS

The planning function is normally separate from the actual implementing of plans. Whereas planning may be carried out by a number of different groups and agencies, the authority to implement plans is normally vested in elected officials.



Sedimentation problems are caused by public, as well as private activities.

Erosion and sediment control provisions in construction and development plans may be implemented in a number of different ways, depending upon local variations in legal authority. Local plans may be implemented through the use of legal mechanisms such as subdivision, drainage, grading and zoning regulations.

Provisions in subdivisions, grading and drainage regulations for sedimentation control essentially involve a regulatory procedure which makes issuance of construction and grading permits contingent on local government review and approval of developers' project plans. In this way, each development and construction project, whether it is a highway, a subdivision development, or a public facility or utility, is required to introduce appropriate sedimentation control measures in its planning stages. The criteria for approval include control measures called for in areawide or community plans applicable to the project under review. These control measures can be developed from such basic principles as:

(1) fitting development plans to climatic factors, topography, soils and vegetative cover;
(2) reducing the area and the duration of exposed soils;
(3) retaining and protecting natural vegetation wherever feasible;
(4) covering disturbed soils with mulch or vegetation;
(5) mechnically retarding runoff and erosion, and trapping sediment in runoff water and;
(6) providing effective accommodation for increased runoff caused by changed soil and surface conditions during and after development.

Zoning is another legal vehicle which can be used to implement erosion and sediment control. Zoning may be used to restrict the uses of land to those activities for which the geology, hydrology and soils of the area are considered suitable. Flood plain zoning, for example, is often used to limit development in flood risk areas to projects which can absorb high levels of water water runoff.

Planning for erosion and sediment control is not implemented by the publication of a planning document. Instead, implementation is effected when control provisions are incorporated (by policy statement, ordinances, rules and regulations) into the many on-going planning processes within a jurisdiction. In graphic form this concept is illustrated in figure 2.

EVAULATION AND REVISION OF THE CONTROL PROGRAM

The long-term success of the control program depends upon its ability to adjust to changing circumstances and needs. If the physical characteristics or erosion and sediment conditions are altered, as they will be under changing land-use patterns, the control program will need to compensate for the changing needs of the watershed area.

Continual evaluation of the control program is needed in order that is effectiveness can be determined. In this way, the program can be modified to meet new demands, or to adjust to unmet needs. It is desirable, therefore, that an evaluation function be provided for within the program's requirements, and that the evaluation function be made part of the planning – action process. This concept is illustrated in figure 3.

PLANNING FOR TOTAL DRAINAGE AREA

Emphasis throughout this chapter has been placed on the value of planning on the basis of watershed characteristics. In addition, emphasis has been placed on planning for sedimentation control in growing suburban and urban areas.

It is recognized, however, that in many cases a water drainage area may consist of rural as well as suburban and urban locations. Planning should not neglect sediment problems having their source in rural sections of the drainage area because eroded agricultural soil may carry potent pollutants, such as insecticides, into water bodies needed for urban and suburban uses. Erosion from sections of the drainage area which have been subjected to mining operations may also consitute serious toxic threats to domestic water supplies. Therefore, the importance of comprehensive drainage area planning and control is again stressed.

Figure 2

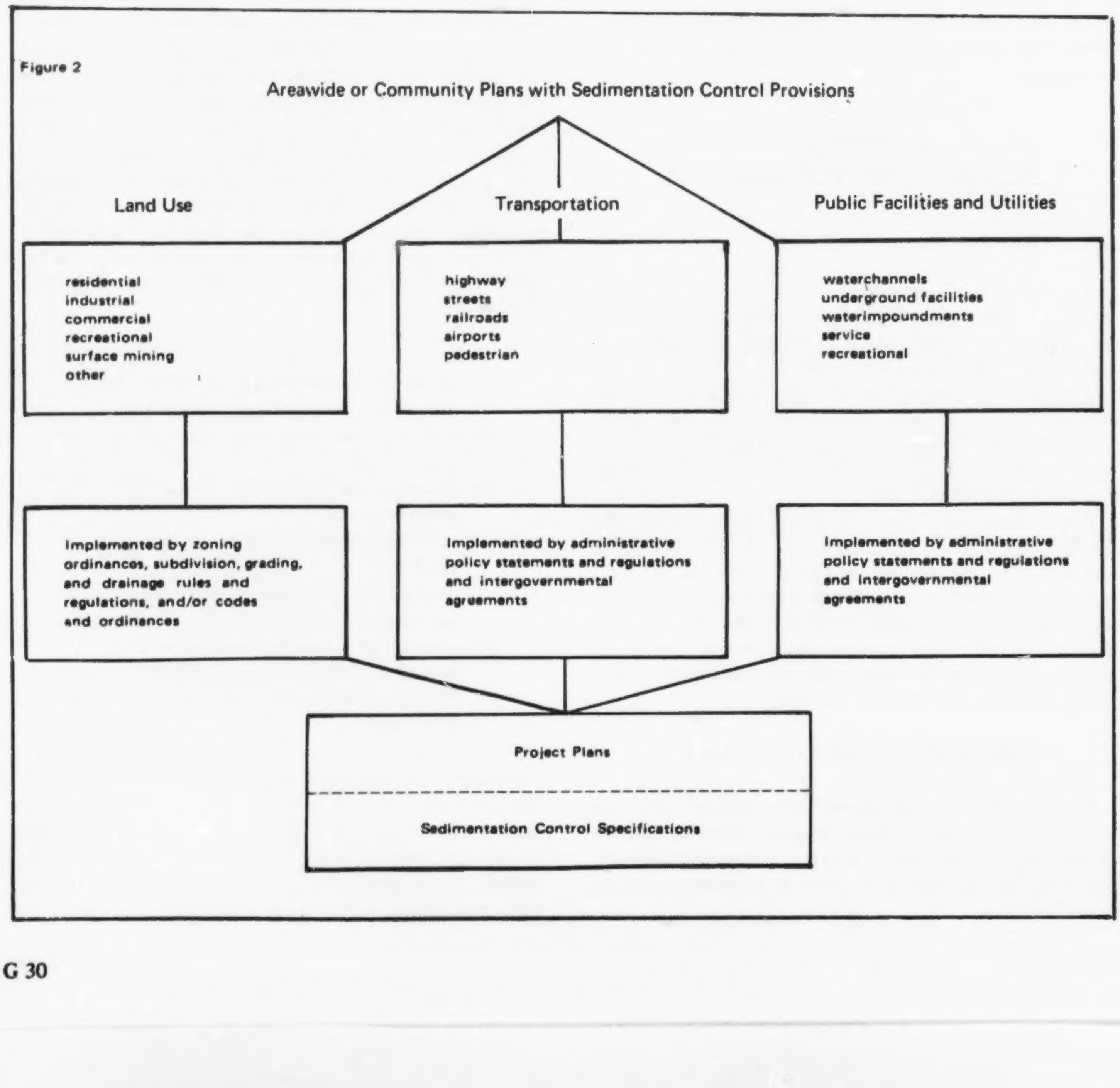
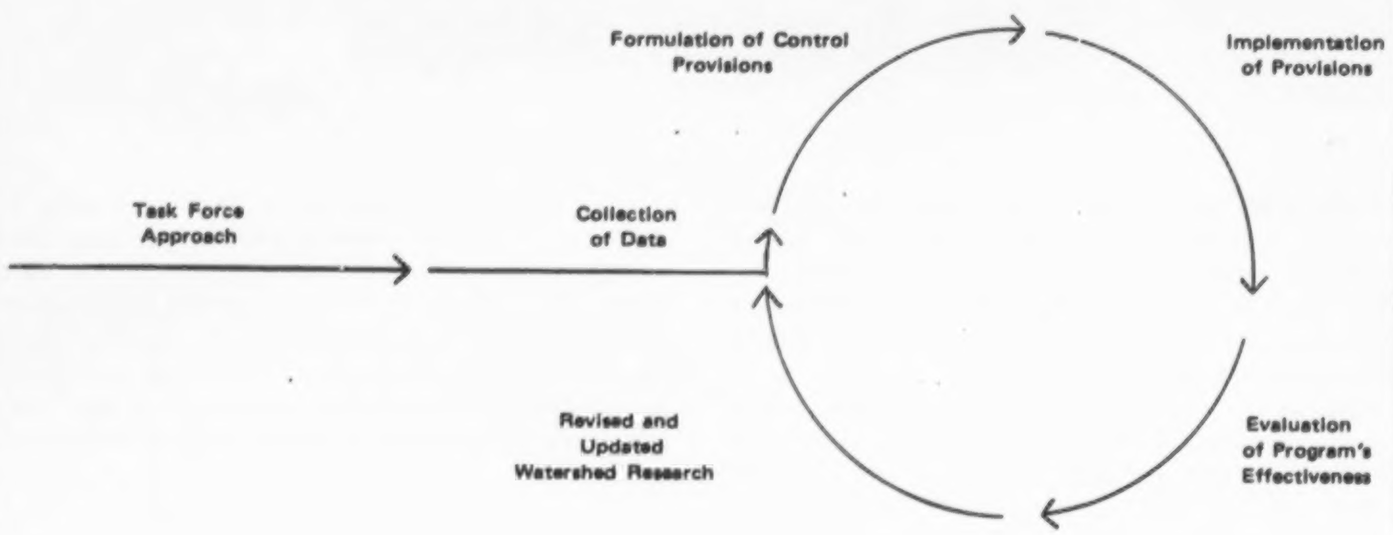

Areawide or Community Plans with Sedimentation Control Provisions
Land Use
Transportation
Public Facilities and Utilities
residential
industrial
commercial
recreational
surface mining
other
highway
streets
railroads
airports
pedestrian
waterchannels
underground facilities
waterimpoundments
service
recreational
Implemented by zoning ordinances, subdivision, grading, and drainage rules and regulations, and/or codes and ordinances
Implemented by administrative policy statements and regulations and intergovernmental agreements
Implemented by administrative policy statements and regulations and intergovernmental agreements
Project Plans
Sedimentation Control Specifications

Figure 3

THE PLANNING–ACTION–EVALUATION PROCESS


Formulation of Control Provisions
Implementation of Provisions
Task Force Approach
Collection of Data
Revised and Updated Watershed Research
Evaluation of Program's Effectiveness

SUMMARY

This chapter has attempted to describe the primary features of planning for soil erosion and sediment control. A major purpose of sedimentation control planning is to provide basic information about erosion and sediment; to identify the nature and extent of erosion and sediment, to determine their sources and causes; to assess the costs and damages inflicted by erosion and sediment; and to determine how and to what extent these problems can be controlled.

By analysing and interpreting basic watershed data, the planning function can help to develop a realistic control strategy which can be applied in the form of a general sedimentation control program. Implementation of the control program is not a function of planning, but is instead a legal and administrative function which is carried out through local ordinances, regulations, and administrative assignments.

Sedimentation control can be planned at various levels and by different agencies but is most likely be effective when it is geared to natural drainage systems as they are affected by suburban and urban development. Erosion and sediment planning is concerned with, and should be directed to, all activities, public or private, which produce sedimentation or which are affected by erosion and sediment. Thus, erosion and sediment control planning should be made an integral part of a community's planning process.

In many cases numerous local agencies will possess the capability to make valuable contributions to the planning activity. It is important to make maximum use of these capabilities and to ensure that all planning activities are coordinated with one another.

chapter six

Public Acceptance and Support

Establishing control over sedimentation problems will frequently involve spending public funds and placing restrictions on public and private activities. Comprehensive control may require, for example, that private developers avoid sediment producing activities, or that flood control operations be funded by public bonding.

Programs of this type require that the public have a general understanding of why funding and controls are necessary and that the public be willing to accept and support such measures. The purpose of this chapter is to describe some basic features of public support for sedimentation control, and to outline some of the techniques that may be used to develop and carry out a public support program.

BASIC FEATURES

The question may be raised as to whether or not the public can realistically be asked to organize in support of erosion and sediment control. Not all segments of the public are affected equally by these problems. In areas where erosion and sediment, in themselves, constitute a direct and major threat to the community, public mobilization directed specifically at these problems may be desirable. As pointed out in other chapters of this handbook, erosion and sediment control programs are ususally viewed as being a part of more comprehensive conservation programs, such as total watershed management efforts. For the purpose of this report then, public acceptance and support programs may be viewed as being applicable, in whole or in part, to total watershed management and resource conservation efforts of which sedimentation control is a part.

Whether for political, social, or economic ends, Americans are prone to organize into groups. While many people do not join formal organizations, most Americans belong to one kind of group or another, and many belong to several groups. Thus, when discussing public support, it is well to keep in mind that the term "public" may refer to people in general, or it may refer to people in organized groups. For the purposes of this chapter, the term "public" shall include both categories.

In view of the fact that public policy in this country is often determined by how effectively various groups and citizens articulate their demands, it should come as no surprise that support for, and opposition to, erosion and sediment control decisions will stem from a variety of different groups. It might be expected, therefore, that homeowners experiencing erosion, sediment, or flood damage will support remedial measures. The task is to develop the support of that part of the public which is not aware that erosion and sediment are inflicting damage on it as well, in the form of indirect costs and environmental deterioration. Efforts to build and maintain public support, therefore, should be concerned with two principal targets. On one hand, these efforts should seek to take advantage of the support offered by various groups, and, in addition to this, should be directed at developing support of the general public.

DEVELOPING PUBLIC SUPPORT

Public support is built upon an understanding of the nature of the problem facing the community. Generally, the public cannot be expected to support a program, the purposes and urgency of which have not been explained. Building public support is a process, not a single campaign. As such, efforts to build support must start at the bottom and develop a basic community awareness of the problem.

Public Information Program

One of the most effective ways to develop community support for erosion and sediment control is to institute a public information program. The community is more likely to accept such a control program, even if necessary inconveniences and expenditures are required, if it is fully informed as to why such action is needed. The process of developing a comprehensive public information program should include the following steps.

(1) Define the problem. Before the public can be expected to support a control program, it will need to understand what the problem is. It is desirable that soil and water problems within local watersheds be clearly identified. This responsibility may be carried out by professionals in the field of soil and water management who are normally available from local agencies such as conservation districts, departments of local governments and other organizations. Whenever possible, technical information should be converted into general language.

(2) Obtain agreement on the part of the decision-makers and civic leaders that identified problems need to be solved. Local officials, citizens groups, business and industrial representatives must be oriented

towards and committed to soil and water management.

(3) Identify the various groups which will likely support or oppose the control effort. The program can then be geared toward potential swing groups, towards converting opposing groups, and towards reinforcing those groups already supporting the program.

(4) Identify the most effective methods by which various groups and the general public can be "reached" and develop an overall strategy with regard to information distribution. This also may include making provisions for coordinating the entire information program.

In most communities there are public as well as private agencies, groups, and organizations which are experienced in conducting effective information programs. Departments of local governments have waged many successful public information programs, as have agencies within state governments. Local, state and federal conservation organizations have conducted such programs for many years. These organizations include state water resources agencies, conservation district, the Agricultural Extension Service, the Soil Conservation Service, and others. Sources of private assistance should not be overlooked.

Carrying Out the Information Program

In connection with sedimentation problems, the general purpose of a public information program is to transmit information and knowledge to the public. Presumably, after receiving this information, the public will be more aware of the problem and more concerned about correcting it. It is important, therefore, that the strategy for informing the public be carefully planned and executed. In order to build a balanced program, capable of consistent performance, it will be necessary to recognize some person or organization as the coordinator or leader.

Whether an information campaign is carried forward by local groups, an agency of local or state government, or by special consultants, the objectives are to build community awareness, acceptance, and support. Some methods by which the program may be carried out are discussed below.

News Media. Newspapers, radio, television and other news media are among the best avenues for conveying information to the public and molding public opinion. They are interested in news and will not transmit propaganda or publicity. The key to having the help of newspapers, radio and TV is to provide the editors and broadcasters with news, and with information on newsworthy developments. Use of the news media should be carried out systematically, rather than on an unplanned, piecemeal basis.

The Citizens Committee. Citizens committees can play a major role in public education programs. These committees can be very effective agents of community action when they are well organized and well staffed and when they focus on specific tasks. In most cases, conservation and water quality are community issues that are especially well handled by citizens committees, and their support in such programs can be of immeasurable help.

Some members of the public have more serious erosion problems than others.

Citizens groups should keep three basic considerations in mind. First, the key to success is the power to persuade. Effective persuasion requires that the group be well equipped with a solid arsenal of information Second, the group should be as broadly based as possible, possessing as much representative power as the depth and range of its constituency permits. Third, the citizen committee or group should be objective in its approach and avoid antagonisms.

In addition to citizens committees created for specific purposes, a variety of other local citizens groups are normally ready and willing to cooperate in efforts to promote community resource management. Garden clubs and federated women clubs have been used frequently in such efforts, and with good results. Chambers of commerce are frequently enlisted to give promotional support. In addition, the League of Women Voters in most communities is a particularly energetic and effective group. These groups, through their various subcommittees, can help with the information program.

Speakers Bureaus. Speakers bureaus have become major educational tools. Through "pools" of speakers, a program can make its activities known to civic clubs, schools, garden clubs, and many other community organizations seeking speakers.

Through the bureau approach, speakers can be drawn from a variety of backgrounds and professions, including public officials, educators, doctors, lawyers and technical experts in a number of fields. In some cases, it may be wise to send "teams" of speakers so that the problem in question can be covered from various angles such as political, engineering, legal, financial, etc.

Public Hearings. Public hearings and discussion groups are also effective mechanisms of information dissemination. Actually, hearings and discussions should be viewed as a learning experience, in that they serve to provide an education process. Hearings and discussions can also serve as sounding boards for public opinion, so that information and education flows in both directions.

Public hearings discussions and speeches can be enhanced through the use of movies, pictures, slides, and other audio-visual techniques. Many local agencies, such as conservation districts and public works departments, have collections of appropriate pictures and slides that are available for various events. Before-and-after pictures of various problems are especially convincing.

Printed Material. An ample supply of well-documented, attractive printed material can, if properly distributed, become a central feature of the public information program. Illustrated maps, charts, and fact sheets are widely respected as being an effective method of reaching the public. Citizens groups are frequently helpful in preparing and distributing these materials, and in arranging public exhibits.

Field Trips. Field trips are excellent ways of conveying information on resource conservation to interested groups. Examples of the problem(s) and the procedures used for the solution can be seen. A more thorough understanding often is obtained this way rather than through other efforts at public education. Local civic groups, businessmen, students, and many others may benefit from field trips.

Citizen Involvement as a Mechanism of Support. It seems to be human nature that people are less willing to criticize those programs which they have helped to develop. Many communities have found that when citizens are involved in a project (any kind of project) they are more likely to support it. Involvement can be a key source of support.

The question arises as to when is it best for citizens to

Environment in the Schools

FOX CHAPEL, PENNSYLVANIA

Fox Chapel Bureau is a small suburban community located near Pittsburgh, Pennsylvania. In this small community of a little over seven square miles, citizens have taken an active interest in the conservation of local resources and natural beauty.

In 1949, a Conservation Council, consisting of a union of garden clubs was formed to help promote community interest in maintaining a clean environment. This groups is now known as the Conservation Council of the Fox Chapel Area.

In the 1960's, threats to the environment, such as erosion, insecticides, and stream pollution began to accelerate. Recognizing these threats as long-range environmental problems, the Conservation Council began promoting a program of environmental and ecological education in the Fox Chapel Area District Schools. The basic purpose of the program is to educate an entire generation of citizens to understand their relationship to their environment, and to sentitize them to the need for a clean, habitable place to live.

A succession of approaches for institutionalizing environmental education were made, including the following steps:

1. *Disseminating information to administrative staffs, and school boards of public and private schools in the district, through letters, articles, lectures and films.*
2. *Campaigning for retention of land adjacent to schools (which had been put up for sale) by attending school board meetings, arranging interpretive nature walks with school administrators and board members, and by bringing in eminent conservation authorities as consultants.*
3. *Sponsoring scholarships to audubon camps for key teachers and upper classmen in high school.*
4. *Conducting panel discussions and lectures to parent–school organizations and garden clubs.*
5. *Conducting a workshop with invited consultants and a film on school site development for outdoor education.*
6. *Supporting the appointment of a new school superintendent with a special concern for environment.*
7. *Introducing the new superintendent to the Conservation Council program and keeping him informed of its action.*
8. *Supporting a key biology teacher, making possible a year of study related to developing environmental education curriculum.*

In 1969, the school board of the Fox Chapel Area School District voted to approve the additon of a kindergarten through twelfth grade curriculum in environmental and ecological education with the chief high school biology teacher being appointed coordinator of this program.

High school upper classmen now use local parks and nature preserves for their studies. They also assist in guidance of the youngest children in outdoor exploration and interpretation. This park–school program will be used in the summer recreation experience of neighborhood children. The Conservation Council of the Fox Chapel Area hopes the program will serve as a pilot project which will be adopted by other school districts.

become involved. The answer, based on the experiences of some communities, is at the very beginning of the program, in the planning phase. The planning phase is the point at which the best citizen understanding of the purpose and scope of the program can be developed. Many crucial decisions have to made in the planning phase which will help determine the future of the program. Early citizen involvement, in the form of advisory committees, public hearings, and through the public information program, can help reduce resistance at a later time.

Local leaders need to get other key leaders involved at the very beginning. Public officials, for example, who must make key policy decisions concerning the program's implementation, should become intimatley involved, for much depends upon their understanding and support of the program.

Schools and the Environment

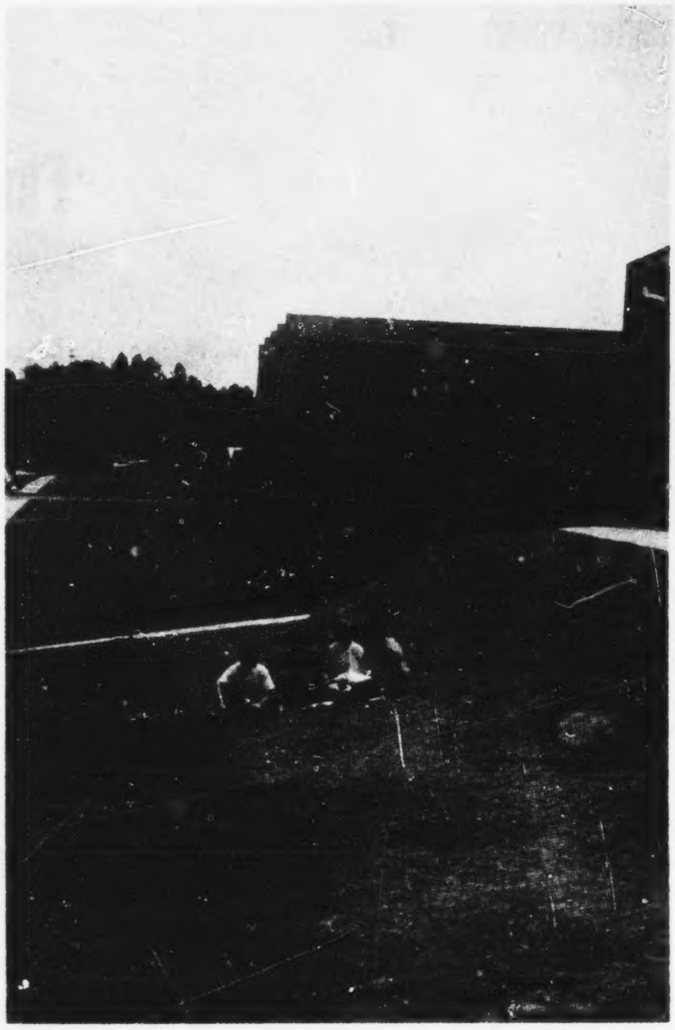
Americans need to know about, and learn to appreciate, the mutually dependent relationship they share with the natural resources that sustain them. They need to consider the impact they are having on their environment. Schools represent the most effective instrument of long-range conservation education. About one-fourth of the nation's population–over 50 million people–are high school or elementary school students.

In school science courses, such as geography, biology, geology, health, and others, there is a need to teach the physical characteristics of watershed drainage, resource conservation and how the various natural elements, including man, depend upon each other for survival. In this connection, the watershed provides a living laboratory for science students of all ages.

Economics and math classes can study resource conservation from a different point of view. Such approaches might include studies of cost-benefit concepts and other conservation management techniques.

In a long range sense, the social studies curriculum may be charged with the most profound responsibilities. Social studies courses must share a major responsibility for transmitting, from one generation to the next, the cultural codes, mores, social values, and attitudes by which the nation lives and the objectives towards which it strives. Thus, social studies courses should teach that resource management must be placed high in the nation's system of priorities. Social studies classes could, for example, concern themselves with the values held by institutions that determine how natural resources are used. History classes could study how the use of natural resources has influenced the economic, cultural, and aesthetic development of communities, states, and the nation.

Seven out of ten of today's students live in urban or suburban areas. The schools that educate these students must start developing a conservation-oriented urban citizen. Such a wide-range program must start with the proper education of teachers. The colleges and universities need to develop principles of conservaton education that can be taught to future teachers. This means that conservation must be made a part of college, high school, and elementary school instruction programs.



Using sound conservation principles during development can promote environmental quality.

SUMMARY

This chapter has attempted to explain why public support for sedimentation control is important and has provided a general outline of some of the procedures and methods that may be used to develop public support. In many cases, it may be unrealistic to mount a full-scale public information program designed exclusively for erosion and sediment control. Instead, such a program should be geared toward building public awareness of, and concern for, comprehensive watershed management.

Many groups are likely to be involved in building public support for resource conservation and management programs. It is desirable therefore, that various efforts to develop and carry out public information programs be coordinated. Preferably, a leader should be chosen to discharge the coordinating function.

Environmental quality is a grave problem which is receiving more and more national attention, and as the nation advances into the 1970's it may be reasonable to expect that programs seeking to improve environmental quality will receive considerable public support. Local officials, therefore, will not only need to help build public support for environmental programs, but they will also need to ensure that public support is effectively used.

chapter seven

Finance

This chapter is designed to present the financial basis for public erosion and sediment control programs. For purposes of this report, however, discussion of finances is not meant to relate exclusively to erosion and sediment control operations. As pointed out in other chapters of this guidebook, erosion and sediment control programs are usually considered as being a part of more comprehensive conservation efforts, such as total watershed management programs. This is true because most operations for erosion and sediment control also serve other objectives of areawide water purification. Therefore, this chapter may be viewed as being applicable, in whole or in part, to total watershed conservation efforts.

This chapter is divided into four parts: the basic factors of a financial program, sources of revenue, purchasing techniques, and financial and technical assistance. The first three parts are presented in outline form to expedite review of basic information.

BASIC FACTORS OF A FINANCIAL PROGRAM

A community's ability to secure ready funds from banking firms or bond houses to fund public improvement projects related to sedimentation control depends on at least three basic factors: adequate legal authority, credit quality, and proper comprehensive financial planning.

Legal Authority Needed

(1) To enter into contracts and intergovernmental agreements
(2) To incur indebtedness
(3) To levy taxes
(4) To refund for lower interest rates
(5) To issue liens against property for delinquent taxes
(6) To increase or eliminate debt limitations
(7) To accept grants-in-aid
(8) To pass supplemental appropriations

Credit Quality

(1) The economic base of the local jurisdiction
(2) The nature of the institutional and legal means available for protecting bond investors
(3) The general administrative and management performance of local public officials

Comprehensive Financial Planning

(1) Program goals and objectives
(2) Projected projects costs (i.e. cost analysis)

    (a) Planning costs
    (b) Principal and interest payments
    (c) Capital improvements costs (i.e. capital improvement budgeting)
    (d) Operation and maintenance costs

SOURCES OF REVENUE

Sediment control programs can be financed through traditional local government funding methods, and through private sources. The former include appropriations from the general fund, special assessments, bonding, and federal and state assistance. The latter is derived from private developers or their contractors. Federal and state assistance is discussed later in this chapter in the section titled Financial and Technical Assistance.

General Tax Fund

(1) Property taxes
(2) Local income taxes

Special District Assessments

(1) Usually based on front footage or area served rather than property value
(2) May be levied against all properties in the district including property normally exempted from tax
(3) Jurisdictional forms

    (a) drainage basin
    (b) Subdivision development
    (c) County
    (d) Intergovernmental service district

Bonding

(1) General obligation bonds

    (a) Usually carry low interest rates
    (b) Generally must be approved by public referendum

(c) Secured by ad valorem taxes levied upon the entire community
(d) Appropriate for financing construction (e.g., reservoirs, storm drains, and water channel improvements) and the acquisition of land

(2) Special assessment bonds

(a) Payable from special assessments on the property benefited by the bond funded project
(c) Appropriate for funding facilities for special service areas which are under the control of county officials

(3) Revenue bonds

(a) Are used for "self-liquidating" projects where a direct service is provided on a use or service charge basis
(b) Do not compete with other projects for the tax revenue
(c) Generally do not come under debt limitations
(d) Are not secured by the faith, credit and taxing power of the local government
(e) Generally have relatively high interest rate
(f) Might have protective covenants in the bond issue which will be too rigid and inflexible in the future

Contributions from Developers

It should be recognized that most erosion and sediment control measures can be funded by developers and contractors as a part of their normal construction activities. Sediment control programs in several Maryland and Virginia counties, for example, require developers to provide all necessary temporary and permanent control measures. The measures required include vegetation and minor structural improvements. (However, the cost of major improvements–dams, open channel linings, reservoirs, etc.–is normally funded through local, state, federal, or intergovernmental multipurpose projects.) For information on legal mechanisms used to implement these programs see the Chapter on Legal Authority.

PURCHASING TECHNIQUES

Equipment needed for sediment control operations very often is available as part of the conventional equipment found in most community inventories. However, when an additional piece of equipment is needed, such as a hydroseeder or mulcher, several alternative purchasing techniques may be considered.

Pay-As-You-Go-Financing

(1) Based on accumulation of funds in advance of purchases or make purchases within the limits of funds on hand.
(2) Major advantage: absence of long term interest rate charges and uncertainties attending subsidies, grants-in-aid, or bond issues
(3) Major disadvantage: it may be better to borrow now and pay later, because of inflation

Intergovernmental Agreements

(1) May be used to supplement equipment, as necessary, anywhere within an areawide scope
(2) Can be entered into with special purpose organizations, especially conservation districts which often have sediment control equipment available on loan

Leases

(1) Can be employed between local governments or between a local government and a private firm
(2) Require no capital investment
(3) Allow flexibility for meeting changing conditions in terms of the amount or type of equipment needed
(4) Disadvantages include: leasing costs are normally much higher than any borrowing rate; and rental payments do not produce any equity in equipment

FINANCIAL AND TECHNICAL ASSISTANCE

Aid to local government programs takes the form of advisory, technical, and informational assistance; as well as grants, loans, advances, and guarantees.

Federal Assistance

Federal technical assistance is largely investigative and advisory in nature supplemented by published articles, reports, and surveys. This form of assistance is available to local governments through their state officials or through regional and local federal offices.

Federal financial assistance to local government is primarily in the form of grants-in-aid and shared revenue. According to the *Vice President's Handbook for Local Officials*, it has been estimated for 1968 that $17.2 billion, or 98.7 percent of total expenditures for aid took the form of grants. Shared revenue is estimated at $223 million, or 1.3 percent. Apart from these types of federal aid other expenditures affecting local government finances include contractual payments or grants to public educational institutions for research, and the training of manpower in specialized areas.

Matching provisions, requirements causing states or localities to share in program costs, are a part of most grant programs. Cost sharing requirements generally take one of two forms: they may be variable matching which takes into account differing financial abilities between states or localities, or they may be fixed-ratio matching which requires all recipients to pay the same percentage of program costs.

Federal Assistance and Research Programs

Federal assistance and research for soil erosion and sediment control projects are not easily ascertainable. This is true for a variety of reasons, including: a lack of programs directly related to sediment control; a multitude of programs that appear to be indirectly concerned with sediment control; current emphasis on more easily identifiable sources of pollution; vague language regarding the applicability to urbanizing areas of programs traditionally active in rural sectors; and the lack of comprehensive and informative descriptions of existing programs.

Accordingly, the programs outlined below may not include all federal assistance available or they may be incomplete in terms of eligibility standards. Local officials, therefore, should contact the nearest field representative for those programs for which they may be eligible in order to receive comprehensive consultation on all possible eligibility and cost-sharing requirements.

Programs are listed according to administering executive departments, and to department subdivisions which may be contacted for information in addition to that provided below. Addresses for department subdivisions follow the last of a subdivisions' listed programs. Addresses for the departments' area or regional offices are provided in the appendix. Program titles are followed by parentheses containing citations of that program's authorizing legislation.

I. Department of Agriculture

(1) National Cooperative Soil Survey Program (16 U.S.C. 590a-590f)

This program, carried on in cooperation with state agricultural experiment stations and other agencies, provides soils information essential for developing sedimentation control planning provisions. The different kinds of soil are studied, mapped, and interpreted. These soil surveys are then published. Modern soil surveys provide information about the properties of soil to a depth of about 6 feet. They show wetness, overflow hazard, depth to rock (within 6 feet), hardpans, other layers,-erodibility, and the hazard of soil slippage on slopes. Through soil survey maps and interpretations, the suitability or limitations of soils for certain uses can be shown.

Examples of printed information available:

List of Published Soil Surveys
Know the Soil You Build On, AIB 320
Know Your Soil, AIB 267

(2) Watershed Development and Flood Prevention Program
(*Watershed Protection and Flood Prevention Act;* 16 U.S.C. 1004, 1005 [Supp V])

This program provides technical and financial assistance to states and their political subdivisions in planning, designing, and installing watershed improvement works; in sharing costs of flood prevention, irrigation, drainage, and sedimentation control; fish and wildlife developments, and public recreation; and in extending long-term credit to help local interests with their share of the costs. Flood prevention measures are eligible for federal funds covering full cost of construction and engineering. Costs for non-agricultural water management measures such as municipal or industrial water supplies are assumed entirely by local interests.

Any state, county, municipal, or other nonprofit organization with authority to carry out, maintain, and operate water supply improvements may sponsor a watershed project.

The watershed project area must be smaller than 250,000 acres and must not include any single structure with a total capacity of more than 25,000 acre-feet. Project benefits must be in excess of costs.

Examples of printed information available:

What the Soil Conservation Service Does, SCS-CI-3
Local–State–Federal Watershed Projects, SCS-CI-4
Watershed Loans, PA-406
Multiple–Purpose Watershed Projects, PA-575

(3) Soil and Water Conservation Program (16 U.S.C. 590a–590f)

This program offers technical assistance required by landowners to solve land and water problems. The Soil Conservation Service, principally through conservation districts, gives on-site help in developing, applying and maintaining sound soil and water conservation plans, and helps groups of individuals and organizations with programs for entire watersheds.

The trained conservationists include: soil scientists; agricultural, irrigation, hydraulic, drainage, and cartographic engineers; economists; and specialists in woodland, agronomy, biology, range management, plant materials, geology and sedimentation. SCS technicians assist in the application of the more difficult practices called for in the conservation plan, such as layout for contouring, the designing and supervising of construction of drainage and water-disposal systems, irrigation systems, terrace systems, diversions and waterways.

Technical assistance, designed to help solve planning problems involving soil, water and related resources, is available to individual and group landowners. In certain programs (Watershed Protection and Flood Prevention, Resource Conservation and Development, and the Great Plains Conservation Program), financial assistance is also available for specified work.

Examples of printed information available:

Soil Conservation Service, PA-818
What the Soil Conservation Service Does, SCS-CI-3
Soil Conservation at Home AIB 321

Our American Land, AIB 321
Sediment, AIB 325
Published Soil Surveys

For more information regarding the above programs, contact:

Soil Conservation Service
U.S. Department of Agriculture
Washington, D.C. 20250
or:
Local Soil Conservation Service Office
or:
Local Soil Conservation District

(4) Soil and Water Conservation Research (16U.S.C. 590a–590f)

The Agricultural Research Service conducts research on soil and water conservation including erosion and pollution control, sedimentation and hydrology. This program provides technical information for federal, state and local agencies and private engineers working on sediment control programs.

This program provides grants of up to 50 percent of the cost of public facilities including water and sewer systems, and flood control projects. Severely depressed areas that cannot match federal funds may receive supplementary grants to bring federal contribution up to 80 percent of the project cost.

Examples of printed information available:

Predicting Rainfall–Erosion Losses from Cropland East of the Rocky Mountains, Agriculture Handbook 282

Summary of Reservoir Sediment Deposition Surveys made in the United States through 1965, USDA Misc. Pub. 1143

For more information contact:

Soil and Water Conservation Research Division
Agricultural Research Service
U.S. Department of Agriculture
Beltsville, Maryland 20705

II. Department of Commerce

Economic Development – Grants and Loans for Public Works and Development Facilities *(Public Works and Economic Development Act of 1965;* 42 U.S.C. 3121)

This program provides grants of up to 50 percent of the cost of public facilities including water and sewer systems, and flood control projects. Severely depressed areas that cannot match federal funds may receive supplementary grants to bring federal contribution up to 80 percent of the project cost.

Loans are also available for public works and development facility projects. These loans may pay the full cost of a project and may run for as long as 40 years, the interest being determined by government borrowing costs. A community that is unable to raise its share of the eligible project cost may receive a grant for 50 percent or more of the project's cost and a federal loan for the remainder of the cost.

States and local subdivisions thereof, Indian tribes, and private or public non-profit organizations or associations representing a redevelopment area or an economic development center are eligible.

Examples of printed information available:

EDA Handbook
Building Communities with Jobs, EDA
Grants and Loans for Public Works and Development Facilities, EDA
Areas Eligible for Financial Assistance
Guides for Overall Economic Development Programs
Economic Development Directory of Approved Projects

For more information, contact:

Economic Development Administration
U.S. Department of Commerce
Washington, D.C. 20230

Economic Development Administration Area Offices
(See appendix for addresses)

III. Department of Defense

(1) Flood Plain Management Services Program (33 U.S.C. 707a)

This program includes preparation of flood plain information reports and special reports on flood hazards, and technical services and guidance toward reduction of flood damage potentials. Services include interpretation of basic data and assistance in planning for land-use regulations, for possible flood modification structures, and for application of flood concepts. Non-federal interests are encouraged to provide mapping, aerial photography, stream flow records, and related assistance.

Examples of printed information available:

Flood Plain Management and Flood Plain Management Services
Guidelines for Reducing Flood Damages

(2) Limited Water Resources Development Projects (33 USC 426 g, 701a, 577, 603a, 701r)

This program provides the Chief Engineers with general authority to undertake flood control, navigation, and beach erosion control projects of limited scope. Federal assistance includes studies of the problem involved, and construction of restorative and protective works. Cooperation requirements for non-federal interests are the same as for the above program and in addition, the following as appropriate:

(a) Small Flood Control Projects–all project costs in excess of the federal limit of $1 million;
(b) Small Navigation Projects–all project costs in excess of the federal limit of $500,000;
(c) Small Beach Erosion Control Projects–all project costs in excess of the federal limit of $500,000; and
(d) Snagging and Clearing Projects for Flood Control–all project costs in excess of the federal limit of $100,000; and
(e) Protection of Essential Highways, Highway Bridge Approaches, and Public Works–all project costs in excess of the federal limit of $50,000.

For more information regarding theses programs, contact the nearest U.S. Army Division or District Engineer or:

Director of Civil Works
Office of the Chief Engineer
Department of the Army
Washington, D.C. 20315

Financing Major Control Measures

ALBUQUERQUE, NEW MEXICO

Albuquerque's age-old erosion and sediment problems are the direct result of wind and infrequent but intense summer rains. The latter swell the arroyos which lead from the east and west mesas to the city located below in the Rio Grande River Valley.

To control the waters running off the mesas and ponding in the river valley, local citizens sought assistance from the U.S. Corps of Engineers which (along with the U.S. Bureau of Reclamation) has responsibility for controlling floods in the Rio Grande River. As the Corps of Engineers could not undertake corrective measures without there being a local sponsoring agency, public pressure resulted in legislative action by the state legislature (March, 1962) creating the Albuquerque Metropolitan Arroyo Flood Control Authority.

The first objective of the Authority was to adopt a plan for controlling arroyo floods. After public hearings and the investigation of many schemes, the so-called "Twin-Ditch" plan was adopted as the official plan of the Authority. Briefly, the plan called for two open concrete lined channels known as the "North" and the "South" channels, parallel and on the east side of the Rio Grande, to intercept the arroyos before they flow into the city, and discharge them downstream into the Rio Grande.

Other major tasks of the Authority were to:

1. *Acquire all needed right of ways.*
2. *Remove or relocate all existing utilities.*
3. *Design and construct all needed roads and bridges.*
4. *Make a cash contribution to the U.S. Government of the construction of the North Channel equal to 3.4% of the total cost of this Channel.*
5. *Make a cash contribution to the U.S. Government for the construction of the South Channel equal to 3.4% of the total cost of this Channel.*

To secure the large sums of money needed to fulfill these obligations, the enabling act establishing the Authority gave it the bonding power with a statutory limit of $12,500,000 on the amount of debt that could be outstanding at any one time. A bond resolution was passed (July 20, 1963) calling for the issuance of general obligation bonds in the amount of $9,500,000, and a date was selected for an election to approve the bond issue. After approval by the voters, the Authority, assured of funds, adopted a resoulution pledging cooperation with the Federal Government in flood control work. The resolution received an endorsement of acceptance by the District Engineer of the Albuquerque U.S. Army Engineer District, thus clearing the way to receive financial assistance through the U.S. Corps of Engineers.

Also, following approval by the voters of the bond issue, a test suit was filed in order to prove the constitutionality of the legislative act which created the Authority. This latter step was deemed necessary as a prerequisite to advertising and selling the bond issue. A favorable decision was rendered in both the District Court of Bernalillo County and, on appeal, in the State Supreme Court. The last hurdle was thereby cleared, allowing the passage and adoption of a 1965 Bonds Public Sale Resolution by the Board of Directors on November 4, 1964. The bonds were subsequently sold to the lowest bidding financial institution which called for an over-all interest rate of 3.1% per annum over the 13-year life of the bond issue.

IV. Department of Housing and Urban Development (HUD)

(1) Advance Acquisition of Land *(Housing and Urban Development Act of 1965,* sed. 704, as amended, 42 U.S.C. 3104)

This program provides grants for the advance acquisition of land that communities will need for future construction of public works and facilities. Grants are made in amounts not to exceed the reasonable interest cost of financing the acquisition of land for a period of up to five years in advance of its use for approved public purposes. In unusual circumstances HUD may allow a period of more than five years. The approved use of the land must be consistent with the comprehensively planned development of the area.

Cities, towns, counties, States, Indian tribes, or a public agency or instrumentality of one or more municipalities established to finance capital improvements are eligible., Application is made to the HUD Regional Office serving the area in which the land is located.

(2) Public Water and Sewer Facilities *(Housing and Urban Development Act of 1965,* sec.702, as amended, 42 U.S.C. 3101)

This program provides grants covering up to 50 percent of land and construction costs for new water and sewer facilities basic efficient and orderly areawide community growth and development. The facilities must be consistent with a program for a coordinated areawide water and sewer facilities system which is part of the comprehensively planned development of the area. A grant may be up to 90 percent, under certain conditions, for communities with population under 10,000. Cities, towns, counties, Indian tribes, or public agencies or instrumentalities of one or more states, or one or more municipalities established to finance specific capital improvement projects are eligible.

(3) Open Space Land Program (*Housing Act of 1961,*as amended, 42 U.S.C. 1500–1500e)

This program provides grants to help communities acquire and develop land to help provide needed park,

recreation, conservation, scenic, and historic areas. Acquisition and development of open space land must be in accord with local and areawide comprehensive planning. A grant to acquire developed land in a built-up urban area may be made only if there is no suitable undeveloped land in the same area.

A grant may be awarded up to 50 percent of the cost of acquiring the needed land. Further grants for developing land acquired under the program may be made up to 50 percent of improvement costs.

Eligible acquisition costs include those for acquiring land and certain structures, demolition of inappropriate structures, and real estate services. Eligible improvement costs include basic facilities (e.g., landscaping) but not major construction. State and local public bodies with authority to acquire and preserve open space land and to contract for federal funds are eligible.

(4) New Communities (*HUD Act of 1968,* 42 U.S.C. 3901 et seq.)

Bonds, debentures, notes, or other obligations issued by private developers to finance the cost of acquiring and developing land for new communities may be guaranteed by HUD. Within a limit of $50 million for any one community, and based on HUD's estimate of value and cost, the guaranteed amount may be up to whichever is less: 80 percent of the value of the property when land development is completed; or the sum of 75 percent of the value of the land before development is completed; and 90 percent of the actual cost of the land development (not including buildings).

Supplemental grants of up to 20 percent of facility cost are authorized for new community water and sewer or open-space facilities assisted with other federal grants. The total federal grant amount may not exceed 80 percent of facility cost.

Approved private developers may receive guarantees. States and localities providing a new community development with federally assisted water and sewer and open space facilities may receive supplemental grants.

(5) Public Works Planning Advances (*Housing Act of 1954,* sec. 702, as amended, 40 U.S.C. 462)

A program to help communities plan for essential public works and community facilities. Interest-free advances are made to cover the cost of feasibility studies and of preparing engineering and architectural plans for needed public works. This planning aid may be used for all types of public works except public housing. Examples of public works that can qualify are water and sewer systems, public buildings, health facilities, recreational projects, and bridges. The planning advance is repayable to HUD when construction of the planned public work begins. The eligible applicant may be any non-federal public agency that is legally authorized to plan, finance, and construct the proposed project. Such agencies include states, counties, other political subdivisions, special districts, regional and metropolitan public agencies, and Indian tribes.

(6) Public Facility Loans Program (Housing amendments of 1955, 42 U.S.C. 1491-1497)

This program provides long-term loans (up to 40 years) covering up to 100 percent cost of a variety of public works projects including the construction of water and sewage facilities, recreation facilities street improvements, public buildings (except schools), and other public works. Loan aid is available only for those parts of a project not covered by aid provided under other federal agency programs.

Those eligible for funding include local units of government or state instrumentalities (cities, towns, villages, townships, counties, public corporations or boards, sanitary or water districts, or Indian tribes) having the legal authority to build public works and issue bonds to pay for them. The applicant community must have a population of under 50,000. In designated redevelopment areas population may be up to 150,000, while areas near research and development installations of the National Aeronautics and Space Administration are not subject to a population limit. A non-profit private corporation serving a community under 10,000 population also is eligible for assistance but for water and sewer facilities only.

(7) Planned Areawide Development (*Demonstration Cities and Metropolitan Development Act of 1966,* 42 U.S.C. 3331–3339)

A program of supplementary grants to encourage states and localities to cooperate in the development and implementation of effective areawide comprehensive planning and programing in multijurisdictional areas.

Grants of up to 20 percent of project costs are authorized to supplement federal grants made under any of 10 other federal grant programs for the following types of projects: basic water and sewer facilities, libraries, hospitals and medical facilities, sewage treatment works, highways, airport development, urban mass transportation facilities and equipment, acquisition and development of land for open space, urban beautification and improvement, historic preservation, acquisition and development of lands and waters for recreational purposes, and public works and facilities in redevelopment areas. The total federal contribution may not exceed 80 percent of project costs.

The applicant may be any state or local public body which

- (a) has, within the current one-year period, received a grant under one of the specified federal programs for a project located in a "qualified multijurisdictional area," and
- (b) demonstrates that it is assisting in carrying out areawide comprehensive planning and programing.

A "qualified jurisdictional area" is an area which is determined by HUD to evidence superior performance in developing and implementing an effective areawide comprehensive planning system.

(8) Comprehensive Planning Assistance (*Housing Act of 1954,* Sec. 701, as amended, 40 U.S.C. 461)

Grants of up to two-thirds (three-fourths, in some instances) of the cost of a planning project are made to supplement state and local funds for comprehensive planning for areas having common or related development problems. Eligible activities include the preparation of development plans, policies, and strategies;

implementation measures; and the coordination of related plans and activities being carried on at various levels of government. Activities include land development patterns, physical facility needs, such as housing, transportation planning recreation and community facilities, the development of human resources, and the development and protection of natural resources.

Applicants may be State agencies designated by the Governor; metropolitan, nonmetropolitan, and regional planning agencies, including councils of governments; counties, cities, local development districts; Indian tribal bodies; and interstate regional commissions.

For more information regarding the above HUD programs, contact:
Assistant Regional Administrator
for Metropolitan Development
HUD Regional Office
(See appendix for addresses)

(9) Code Enforcement Grants (*Housing Act of 1949,* Sec. 117, as added by *Sec. 311[a] 42 U.S.C. 1468) Housing and Urban Development Act of 1965* Sec. 311 (a), 42 U.S.C. 1468)

A program to aid development of concentrated code enforcement programs and to provide adequate supporting facilities and and services for the purpose of helping communities restore the stability of neighborhoods and prevent blight.

Grants of up to two-thirds of program cost for municipalities over 50,000 population and up to three-fourths of program cost for municipalities 50,000 or under in population are made for planning, reviewing, and administering concentrated code enforcement programs in selected local areas. Eligible project expenses include planning, administration, and public improvements, such as necessary streets, sidewalks, curbs, street lighting, tree planting, and similar improvements. Direct federal three percent rehabilitation loans and rehabilitation grants are available to eligible owners and tenants of property in the area.

Eligible applicants may be cities, municipalities, and counties having legal authority to enforce housing, building, and related codes. The community must have a current certified Workable Program for Community Improvement, must have adopted and be enforcing a comprehensive system of codes that meet minimum standards, must agree to maintain normal levels of expenditures for code enforcement exclusive of an expenditures required for the project area, must provide relocation assistance to all those displaced by project activities, and must provide at local expense all public facilities that are necessary to accomplish the purpose of the program.

For more information, contact:

Assistant Regional Administrator for Renewal Assistance
HUD regional office (See Appendix for address)

V Department of the Interior

(1) Geologic, Mineral, Water Resource, and Topographic Surveys, Investigations, and Research Program (43 U.S.C. 31, 41, 50)

Many of the Geological Survey's programs in topographic mapping, geologic mapping, geologic and mineral resources surveys and mapping, and water resources investigations are planned, conducted, and financed in cooperation with state and local governments.

Plans for cooperative programs are initiated jointly and are designed to contribute to national program objectives and responsibilities and at the same time to serve state or local needs.

A clause in the annual appropriation for the Survey requires that cooperating state and local governments must contribute at least one-half the cost of cooperative topographic mapping or water resources investigations.

Examples of printed information available:

Maps, atlases, bulletins, water supply papers, and other documents; also a series of nontechnical leaflets addressed lay readers.

For more information, contact:

Director, Geological Survey
U.S. Department of the Interior
Washington, D,C. 20242

(2) Water Pollution Control–Training Grants and Research Fellowships Program *Federal Water Pollution Control Act* as amended, 33U.S.C. 466, et. seq.)

The purpose of this program is to increase substantially the number and quality of trained professionals, sub-professionals, and others engaged in water pollution control activities.

This is done through training grants and research fellowships. Training grants provide partial support to assist public and other institutions to establish, expand, or improve training opportunities for individuals planning courses in practice, administration, research, or teaching in the field of water pollution control. Research fellowships provide support to highly qualified individuals pursuing advanced degrees in disciplines directly related to and leading to careers in water pollution control.

Public and private universities, colleges or institutions, junior colleges, technical institutes, and educational organizations are eligible. Local officials should encourage their educational organizations to apply if they have not already done so.

Research fellowships are available to eligible individuals. Those interested should apply through the following address or any listed local office.

For more information, contact:

Training Grants Branch
Federal Water Pollution Control Administration
U. S. Department of the Interior
Washington, D.C. 20240

(3) Water Pollution Control–Research Development and Demonstration Program (*Federal Water Pollution Control Act* as amended, 33 U.S.C., 466, et seq.)

The purpose of this program is to develop new and improved methods for the prevention and control of water pollution. Contracts and grants are made for this purpose in the following specific areas:

(a) storm and combined sewers,
(b) advanced waste treatment and joint treatment systems for municipal and industrial wastes,
(c) methods for prevention of pollution by industry, including, but not limited to, treatment of industrial wastes,
(d) practicable means of treating water-borne wastes to remove the maximum possible amounts of physical, chemical and biological pollutants to restore water quality for repeated reuse,
(e) improved methods to identify and measure the effects of pollutants on water uses, including those pollutants created by new technological development,
(f) methods to evaluate the effects on water quality and uses of augmented streamflows to control water pollution not susceptible to other means of abatement.

In both categories (a) and (b), no grant may exceed 75 percent of the project cost, and projects must have the approval of the state water pollution control agency. Under category (c), grants may not be in excess of $1 million or 70 percent of the project cost. There are no matching requirements for contracts.

Under these grants, the technical feasibility and applicability of the method used must be technically evaluated as an integral part of the project.

Contracts may be awarded to public or private agencies and institutions and to individuals. Grants for general research and development, and projects in areas (a), (b), (c), and (f) above, may be made to public or private agencies, institutions and to individuals. Grants in areas (d) and (e) above may be awarded to States, municipalities or intermunicipal or interstate agencies concerned with water pollution control.

Examples of printed information available:

Water Pollution Aspects of Urban Runoff,
FWPCA publication WP-20-15
A Program to Combat Storm Water Pollution,
FWPCA Publication WP-18
Clean Water Fact Sheet
FWPCA Publication
Federal Grants for Clean Water,
FWPCA Publication

For more information, contact:

Office of Research and Development
Project Coordination
Federal Water Pollution Control Administration
U.S. Department of the Interior
Washington, D.C. 20240

(4) Real Property for Public Parks, Public Recreational Areas, and Public Purposes Program (43 U.S.C. 869 [1940] 43 U.S.C. 869 to 869-3 [Supp. V])

State and local grants in the public land states that agree to dedicate new parks for use by all Americans will be able to purchase recreation areas from the National Land Regions for $2.50 and acre or lease them for $.25 an acre per year.

Examples of printed information available:
Community Recreation and the Public Domain
May 1963, U.S.D.I.
Federal Assistance in Outdoor Recreation
Publication No. I.N.A.C.

(5) Real Property for Residential, Commercial, Agricultural, Industrial or Public Uses or Development Program, (*Public Sale Act of 1964*, 43 U.S.C. 1421)

This program provides for transfer of title federal lands that are required for orderly community growth and development, or are chiefly valuable for public uses. Federally owned public domain land may be available for use, lease or purchases to qualified governmental agencies at the appraised fair market value.

Examples of printed information available:

Fact Sheet on Historical Preservation
Fact Sheet on Land and Water Conservation
Federal Assistance in Outdoor Recreation

For more information regarding programs (4) and (5), contact:

Bureau of Land Management
U.S. Department of the Interior
Washington, D.C. 20240

(6) Outdoor Recreation Financial Assistance Program (*Land and Water Conservation Fund Act of 1965*; 16 U.S.C. 460 L–to 460L–11; 23 U.S.C. note)

Financial assistance is available to states and their political subdivisions for planning, acquiring, and developing all types of outdoor recreation areas and facilities. Grants are made on a 50-50 matching basis for approved projects. Basic program objectives are:

(a) Development of projects in areas where concentration of people live.
(b) Projects must be available for use by the general public.
(c) Development of basic rather than elaborate facilities is favored.
(d) Projects furnishing a broad range of outdoor recreation uses and experiences are preferred.

Approved projects, include multipurpose metropolitan parks, snow ski areas, urban playgrounds, golf courses, swimming pools, hiking and bicycling paths, nature interpretation areas, fishing piers, marinas, and boat launching ramps.

States and, through them, local levels of government may apply for a grant-in-aid for an approved outdoor recreation project. All project proposals must be submitted to the Bureau through the state liasion officer.

To be eligible, the state must develop and maintain a current comprehensive statewide outdoor recreation plan. Projects must be in accord with and meet the high-priority needs identified in the state plan. The state liaison officer has the initial responsibility of determining which projects to support and the order in which to request funds.

For more information, contact:

Bureau of Outdoor Recreation
U. S. Department of the Interior
Washington, D.C. 20240

Regional Director, Bureau of Outdoor Recreation
(See appendix for addresses)

State Liaison Officer

(7) Small Reclamation Project Loans for Water Resources Projects (43 U.S.C. 422)

This program provides lands and grants for construction of rehabilitation of water resource development projects which must be primarily for irrigation and be located in the 17 western-most contiguous states or Hawaii. The projects may also cover other purposes including flood control, abating water pollution, fish and wildlife enhancement, and recreational development. Loans are fully reimbursable and grants can be made only for approved flood control, fish and wildlife, and recreation purposes.

Non-federal organizations in the 17 western-most contiguous states or Hawaii which are qualified or which can qualify to contract with the United States Government under federal reclamation laws are eligible.

A descriptive brochure may be requested from the Bureau of Reclamation.

For more information, contact:

Bureau of Reclamation
U.S. Department of the Interior
Washington, D.C. 20240

VI. Department of Transportation

Airport Development Program (*Federal-Airport Act, 1946*, as amended)

This program provides financial aid, conveyance of federal land, and other assistance to public agencies in the planning, acquisition, and development of public airports and heliports.

Property interests in federal lands as well as federal grants, are are available for projects that are essential to the operation and safety of airports.

Grants can be made for land acquisition; site preparation; drainage work, either on or off the airport site; construction, alteration, and repair of runways; taxiways, aprons, and roads within airport boundaries; erosion control; seeding and sodding; and certain other on-site and off-site work.

Sedimentation problems sometimes require major capital expenditures.

The federal government generally provides 50 percent of the cost and the local public authority provides the remaining 50 percent.

State, county, municipal, and other public agencies are eligible if their airport requirements are shown in the National Airport Plan.

Apply to:

FAA Area Offices or FAA Regional Offices
(See appendix for addresses)

Federal Aviation Administration
U.S. Department of Transportation
Washington, D.C. 20590

VII. Appalachian Regional Commission

Appalachian Regional Development Program (*Appalachian Regional Development Act of 1965*, 40 App U.S.C. 1-405)

This economic development program established activities which will contribute to the growth of the Appalachian region. These programs include application of land treatment and erosion control measures; operation of a comprehensive water resources survey, and construction and equipping of public facilities.

States, political subdivisions, local development agencies and districts, non-profit corporations and private citizens in Appalachia are eligible.

Apply to:

Appalachian Regional Commission
1666 Connecticut Avenue
Washington, D.c. 20235

Many of the foregoing programs provide support for soil erosion and sediment control as one of a multitude of purposes. In some of the programs, abatement of sedimentation is a supplemental or secondary provision to other stated objectives. Therefore, with most assistance and research programs sedimentation control will need to be approached as one of a package of community objectives requiring comprehensive planning and coordinated implementation. (See the Chapter on Planning for further information on the relationship between planning and assistance programs.)

STATE ASSISTANCE

Commensurate with the growing awareness of the potential hazards of sedimentation to environmental quality is the increasing availability and magnitude of state aid. One major source of state assistance is that provided by the state soil and water conservation committees, commissions, boards, and councils that administer the laws under which conservation districts are created.

In 1970, for example, the funds appropriated through these agencies in support of conservation district programs reached $31 million. Over half of these funds are used to carry out responsibilities in connection with watershed programs. Others are used for direct assistance for conservation districts, soil survey reports and interpretations, and river basin planning.

In Kentucky, the Division of Soil and Water Conservation, an agency of the State Department of Natural Resources, has a stated policy objective of assisting Kentucky's Soil and Water Conservation Districts and Watershed Conservancy Districts with financial, promotional, educational, and administrative assistance in developing and operating a complete conservation program throughout the state. In terms of financial aid, the Division assists local districts with loans for the purchase of specialized earthmoving equipment. The fund for the loans was created by the state's legislature in 1948 with an appropriation of $400,000 which was increased to $600,000 in 1960, and to $850,000 in 1968. The Division also administers a $125,000 fund each year for district aid to Kentucky's 121 soil conservation districts.

In Wisconsin, where sediment has been declared a pollutant, $72,000 has been made available annually to the State's 72 conservation districts. This is matched by $313,000 from county funding through conservation districts. Most of these funds are spent on erosion control, including, for example, the purchase of hydro-seeders for roadside use.

Local officials should contact their respective state water pollution control agency, and state soil and water conservation agency for information concerning assistance. (See appendix for addresses)

LOCAL ASSISTANCE

Local special purpose organizations, especially conservation districts, should not be overlooked as one of the best sources of technical assistance for sediment control. In cooperation with the Soil Conservation Service, conservation districts prepare soil surveys which determine use capabilities and treatment needs of local soils; help make plans for land use according to survey results; issue erosion control guide standards; and aid in the planning and application of control techniques. This service is available to landowners and developers and their engineers as part of the consultative technical assistance offered by districts.

One method for securing conservation district services, particularly in connection with preparation of technical guides, is the use of a county technical action panel. Composed of appropriate county and conservation district personnel, panels can serve as centers for issuing practical erosion and sediment control guidelines for use by developers, contractors, school boards, and all relevant government agencies operating at the local level.

In addition to conservation districts, other special purpose organizations that local officials should contact for information concerning technical assistance include flood control districts, water conservancy districts, drainage districts, and sanitation districts.

PRIVATE ASSISTANCE

Numerous local and national private organizations provide support for local sedimentation control efforts. They provide assistance through support for local bond issues, and by providing information through publications, newsletters, and films. The Consulting Engineers Council of America, and the American Society of Civil Engineers, issue guidelines on how to select a consultant and can provide a list of member consultants in local areas. The National Association of County Engineers can provide information regarding existing sedimentation control techniques, and can serve as a clearing house for translating and transmitting knowledge of improved techniques as they are developed.

The League of Women Voters and the General Federation of Women's Clubs have been very active in support of land and water conservation efforts through educational and data collection programs. The former organization, for instance, developed a slide show and supplied speakers for civic groups on urban erosion and sedimentation in support of a Fairfax County, Virginia soil conservation program.

The Investment Bankers Association of America and the *Bond Buyer* provide literature on the preparation and sale of local bond issues.

The local Chamber of Commerce and the National Association of Home Builders provide industry's point of view on the sediment problem. The National Association of Home Builders also issues reports on methods for identifying soil erosion problems in connection with land acquisitions and on the basic techniques for sediment control.

Conservation groups can also be approached for help in increasing community awareness of the environmental and monetary costs of sedimentation and in gaining citizen support for necessary bond issues. Local officials should enlist the support and ideas of groups such as the American Fisheries Society, the Conservation Society of America, the

Obtaining Financial and Technical Assistance for Soil Surveys

ST. LOUIS COUNTY, MISSOURI

It is becoming increasingly important that growing counties use soils data as a guide in land-use planning. However, few county governments possess the technical and financial capabilities to conduct soil studies. St. Louis County, Missouri has found that cooperation and coordination can help obtain assistance in conducting such studies.

The St. Louis Metropolitan Area, with a population of 2,310,000 is the ninth largest metropolitan area in the nation. It includes portions of two states, seven counties, the City of St. Louis, and 163 smaller municipalities. As a major component of the metropolitan area, rapidly growing St. Louis County has an estimated 1969 population of 968,000.

The building boom in St. Louis County has been swift and intensive, with about 3,500 new homes being built every year. The construction of shopping centers, schools, and other public facilities has accompanied home building. The building boom has taken place within the county's many watersheds where, unfortunately, the soils have proven to be highly erodible.

The county has recently participated in an areawide effort to obtain soil studies for the county, as well as for the entire metropolitan area. The East-West Gateway Coordinating Council (the St. Louis area council of governments) has acted as the coordinating agency to obtain federal funds to conduct soil studies for the area, including St. Louis County. The purpose of the project is to provide jurisdictions in the area with information on soil slippage characteristics, soil erodibility, shrinkage, permeability, etc.

The East-West Gateway Coordinating Council received financial assistance for the project from a number of sources, including the Department of Housing and Urban Development (HUD) 701 comprehensive planning program.

In addition, the Council is the coordinating agency for the many organizations that have expressed interest in or offered assistance to the program. These organizations include public works agencies, the University of Missouri, the U.S. Geological Survey, planning commissions, the Soil Conservation Service, and funds were also contributed by the Missouri and Illinois State Geological Survey.

The St. Louis area's experience with soil surveys is important because it demonstrates that, when properly coordinated, local, state and federal resources can be employed to meet local and areawide needs.

Sport Fishing Institute,the Izaak Walton League, and the National Resources Council.

One of the best sources for new ideas on the abatement of sedimentation is the annual meeting of the National Watershed Conference. Comprised of more than 27 of the nation's leading industrial, urban, agricultural, and conservation organizations, the Conference provides a forum for the discussion of ways and means of expediting, broadening and improving local watershed programs. For additional information on Conference activities and participation write or call:

National Watershed Conference
1025 Vermont Avenue, N.W.
Washington, D.C.

SUMMARY

Erosion and sediment control, as an integral part of overall water management programs, is a necessary public service which must be adequately financed. There are two basic financial decisions:

(1) how to finance capital requirements; and
(2) how to meet operating costs.

If the local government decides to provide major sediment control measures (i.e., major structural devices and open space lands), then it faces the problem of financing capital requirements. If a more limited and segmented approach is used, local government is still responsible for providing needed remedial measures and maintenance.

Since the program must be financed within the constraints of state laws and local charters, these should be thoroughly examined during the planning process. Local governments can pay for the program through the following methods: federal and state assistance, taxes, bond issues, and developer contributions. The local capital improvement budget should schedule the financing of all major sediment control facilities, equipments, and land acquisitions.

With use of appropriate purchasing techniques, a sediment control program can be operated on an areawide basis and thereby, allow for economies of operation to benefit each jurisdiction involved.

A significant feature of financial and technical assistance for sediment control is that there is an absence of programs specifically designed to aid local sediment control operations. Instead, assistance is normally available through programs which include sediment control as only one of several eligible activities.

It should be noted that not all the benefits from sedimentation control programs are measurable in dollars. Many are intangible, such as improved aesthetic and recreational quality, which are not easily quantifiable yet very essential to continued public health and welfare.

chapter eight

Personnel

Elsewhere in the guidebook, reference is made to implementing sedimentation control programs through the use of a task force of local agencies, instead of creating a separate and autonomous control agency. When staffing for programs using the task force approach, the nature of most personnel management concerns will depend on the current personnel practices of existing agencies. However, three basic elements may be evaluated despite local practices. These are: personnel skills appropriate for carrying out the program, training aspects, and methods of recruitment.

PERSONNEL SKILLS

The following analysis of personnel skills appropriate for carrying out a control program will be made both in terms of professional disciplines and in terms of program functions.

Professionals and non-professionals

Analysis of the number and types of personnel needed for local control programs reveals no obvious pattern that can be used as a model staff. Rather, personnel needs will depend upon factors that may vary significantly between local jurisdictions. These factors include: the current training and experience of existing personnel; the training available for existing personnel; the geological, hydrological and topological nature of the problem; the program's eligibility for technical assistance; the extent of laws, codes, and regulations to be administered; and the extent of cooperation between public agencies and developers.

Although a complete staff model is not feasible, several types of personnel that appear to be basic for effective sedimentation control may be noted. These include soil scientists, planners, soil conservationists, soil engineers, on-site inspectors and hydrologists. Soil scientists can classify and map soils which permits predictions on items such as: erodibility by wind and water; adequacy of different locations for sewage disposal; droughtiness and the need for supplemental irrigation; slippage hazard; presence of salts, alkalinity, or acidity that would inhibit plant growth; potential flood hazards under natural conditions; and suitability for alternate land-uses.

Planners with knowledge of control principles are essential for developing land-use plans and project plans. (For a discussion of planning, refer to the Chapter on Planning)

Soil conservationists can provide erosion and sediment control guidelines for builders, developers, and private citizens and help to implement these guidelines through consultation on specific control measures and practices. Soil conservationists may be defined as generalists in soil and water conservation with knowledge of agronomy and forestry, and of the engineering techniques in designing erosion and sediment control structures.

Hydrologists can study and compile data on the interrelationships between surface water runoff and receiving water courses (streams, rivers, ponds, lakes, etc.), sediment transport and deposition, erosion of shorelines, turbidity, and flood hazards.

A soil engineer is a civil engineer experienced in soil mechanics. His experience may be employed to investigate and report on the stability of existing or proposed slopes; exercise control over the installation and compaction of fills; recommend soil bearing values; and provide design criteria and calculations for special earth structures such as buttress fills. The soil engineer is specifically identified in many grading ordinances in California where the State Health and Safety Code requires each city and county to enact an ordinance requiring a preliminary soil report, prepared by a soil engineer registered by the state.

Inspection personnel include soil engineers, civil engineers with training in hydrology, soil conservationists, and non-professional personnel trained in sedimentation control measures and techniques. Local governments in California supplement the staffs of their local inspection agencies by requiring developers and contractors to employ a soil engineer, registered with the state, with the duty of providing permanent on-site supervision and inspection, and reporting on the progress of construction and grading activities in terms of compliance with previously approved plans.

Functional Needs

Analyzing personnel skills from a functional approach (See the list below) indicates the number of roles that can be assumed by the same personnel. For example, planners, engineers, and conservationists all may be involved in comprehensive planning, community project planning, and in the administration of ordinances, codes, and regulations.

It also demonstrates the adaptability of sedimentation control functions to on-going operations in as much as these functions are normally carried out by most general purpose governments in providing community services. Therefore, most control functions can be carried out by existing personnel with adequate training in control principles and techniques. This should particularly be true in connection with the nonprofessional functions of support services and maintenance.

The following list illustrates the scope of manpower skills both in terms of program functions and in terms of professional background, that may be employed to carry out sedimentation control operations. It should be noted that programs staffing needs will not require the personnel listed more than on a part-time basis.

Function	Professional Title
Comprehensive Planning	planner economist soil scientist water pollution control engineer
Project Planning	planner soil engineer engineering geologist conservationist agronomist landscape (environmental) architect water pollution control engineer
Administration of Ordinances, Codes, and Regulations (includes inspection)	civil engineer (with hydrological knowledge) planner soil engineer engineering geologist conservationist
Legal Services	county or municipal attorney
Support Services	non-professionals including clerical workers, lab assistants and engineering aides
Inspection	soil engineers, civil engineers with training in hydrology, conservationists, and non-professionals
Maintenance	non-professionals
Review and Evaluation	includes those involved in performing the above functions

ORIENTATION

It must be emphasized, however, that given the pressure of urban development and the greater visibility of other environmental problems, sedimentation control may receive insufficient consideration by relevant personnel unless they receive proper orientation and training. Both in-house as well as outside formal training may be needed.

In-house training

In-house training can be effected through official policy announcements requiring group instruction supplemented by literature and outside consultation. Literature can be obtained from local conservation districts, from the National Association of Home Builders, the Soil Conservation Service, the Bureau of Public Roads of the Federal Highway Administration, and the U.S. Department of Transportation. Consulting service, free of charge, is available from state Soil Conservation Service agencies

An in-house training program (two to three hours a week) could be organized as follows:

Date	Subject	May be Presented by
first week	I. Orientation a. Statement of the problem b. Basic principles of sedimentation control	state conservationist (SCS) state water pollution control engineer geologist state hydrologist
second week	II. Seeds and Seeding a. Temporary b. Permanent	state agronomist (SCS) conservation district conservationist
third week	III. Establishment of Vegetation on Critical Areas a. Cut and Fill Slopes b. Waterways c. Vegetative Stabilization	field specialist (SCS)
fourth week	IV. Erosion Control Structures a. Waterways and Diversions b. Sediment Basins c. Grade Stabilization Structures	soils engineer state conservationist (SCS)

through local conservation districts and from state natural resources departments.

Among the personnel that should attend this program are: directors of participating local agencies; planners; engineers; special district representatives; maintenance personnel; directors of inspection personnel; inspection personnel; private developers; private contractors, and their construction superintendents; grading and labor foremen; grading equipment operators; and private engineers and architects.

OPPORTUNITIES FOR PROFESSIONAL TRAINING

Where training requires formal instruction and laboratory experience beyond in-house capabilities (hydrology, engineering, chemistry, etc.), arrangements should be made with state and federal water pollution control agencies for possible assistance.

A recent NACORF survey indicated that 45 states (Arkansas, Louisiana, Nevada, Texas, and Virginia being the exceptions) were conducting training and seminar programs for local government water pollution control administrative and planning personnel. Since sediment is potentially a pollutant under every state water pollution control act, local officials should contact their respective state water pollution control agency for further information (see appendix for addresses of state water pollution control agencies).

At the federal level, the Federal Water Pollution Control Administration (FWPCA) supplements state training programs by offering courses in water pollution control at five locations in the United States: The Robert A. Taft Sanitary Engineering Center in Cincinnati, Ohio; the Robert S. Kerr Water Research Center in Ada, Oklahoma; the Southeast Water Laboratory in Athens, Georgia; the Pacific Northwest Laboratory In Corvallis, Oregon; and the

Orientation and Training

BALTIMORE COUNTY, MARYLAND

Baltimore County, being located within the metropolitan area of the city of Baltimore, is experiencing rapid suburban growth. Sediment from construction and development activities, has polluted county waterways, silted and damaged adjacent properties and clogged storm and sewer systems. To minimize these effects, the county initiated a sedimentation control program in 1968, applicable to all public and private development activities.

A basic element of the Baltimore County program was a seminar and a series of training sessions on sedimentation control prior to implementation of the program. The seminar introduced the general aspects of the program to representatives of all public agencies and private organizations who would be affected by it. The seminar included speakers from private industry and John Hopkins University as well as from county agencies and the Soil Conservation Service. Topics of discussion included:

- *(1) general background on the program*
- *(2) the purpose of the seminar*
- *(3) the transition of sedimentation control practices from rural to urban areas*
- *(4) control through vegetative means*
- *(5) engineering criteria used in control*
- *(6) local sedimentation control problems*
- *(7) implementation of the control program*
- *(8) how the Montgomery County, Maryland control program operates*
- *(9) reaction of Montgomery County Builders and developers to the control program*
- *(10) a summary*

The training sessions, which followed the seminar, were designed to introduce concerned county and private operating personnel to the program's administrative and technical aspects. The sessions were held on four consecutive Fridays for two hours each Friday. The subjects presented at the sessions were as follows:

- *(1) first week - seeds and seeding*
- *(2) second week - establishment of vegation on critical structures*
- *(3) thrid week - erosion control structures*
- *(4) fourth week - implementation of the program*

A unique feature of the seminar and sessions was the wide range of representatives from private and public organizations solicited to attend. These included: developers and their engineers, construction superintendents, foremen, and heavy equipment operators; consulting engineers; county maintenance and inspection personnel; county planners; county engineers; and representatives from the Maryland Highway Builders Association, the Maryland Home Builders Association and the Soil Conservation District.

The wide public and private interest participation produced several significant results:

- *(1) it prepared the community for sediment control before it was implemented;*
- *(2) it served to involve and encourage the cooperation of private industry in providing sedimentation control; and*
- *(3) it provided an exchange of ideas which proved to be significant in connection with a more workable program.*

Hudson - Delaware Basin Office in Edison, New Jersey.

According to the FWPCA *Bulletin of Courses, July, 1969 to December 1976:*

The objective of the training program is to provide specialized training in the causes, prevention, and control of water pollution. Training not generally available elsewhere is featured in specialized subjects, in the field and in the laboratory. It is expected that this training will lead to rapid application of new research findings, increase skills of technical and professional personnel, and train new employees recruited from other professional or technical areas in the special skills required in water pollution control. Scientists, engineers, and recognized authorities from other FWPCA programs, other government agencies, universities, and industry, supplement the training staff by serving as guest lectures and special consultants.

Most training is conducted in the form of highly technical, short-term, courses of one or two week's duration. The scope and level of these courses is designed to meet specific practical features of . . . water quality management and water pollution control.

No tutition or registration fee is charged. However, students must arrange their own transportation and housing while attending courses. For the *Bulletin of Courses* and an application from, write:

Director, National Training Center
Federal Water Water Pollution
Control Administration
U.S. Department of the Interior
4676 Columbia Parkway
Cincinnati, Ohio 45226

FWPCA also provides grants and fellowships in order to substantially increase the number of trained professional and sub-professionals engaged in pollution control. Training grants are available to educational institutions for developing, improving, or expanding training opportunities for individuals taking courses in operations, research, administration, or teaching in the field of water pollution control.

Institutions eligible for training grants are public and private universities, colleges, junior colleges, technical institutes and educational organizations. In areas where training opportunities are lacking, county officials should assume responsibility for obtaining grants for their local educational institutions.

Fellowships are provided for qualified individuals pursuing advanced degrees in disciplines directly related to and leading to careers in water pollution control.

Applications should be made to any listed local office or:

Training Grants Branch
FWCPA
U.S. Department of Interior
Washington, D.C. 20240

RECRUITMENT

Recruitment can be approached in terms of fulfilling staff needs in three separate areas: permanent professional staff, professional needs for short-term projects, and overall non-professional needs. Basic professional needs for permanent program operations include planners, soil scientists, soil engineers, hydrologists, and conservationists with a background in agronomy. Most counties and municipalities can fill these positions with existing personnel by tailoring sedimentation control programs to the on-going operations of public agencies within their jurisdictions. With adequate training, local planning and engineering departments can provide the staffing needed for program planning functions and for technical review and approval of land use plans. Conservationists, agronomists, soil engineers, and soil scientists are normally available through intergovernmental working agreements with local conservation districts while agreements with local flood control or sanitation districts can provide hydrological assistance.

Where professional staff needs cannot be filled by existing personnel, recruitment can be conducted through several outside sources, including university placement bureaus, professional journals, professional associations, and federal agencies. While many schools provide option courses in watershed management, the University of Arizona (Tucson) and Colorado State University, offer a comprehensive "water specialist" curriculum as a major field of study. Graduates are equipped with knowledge of soils, hydrology, plant physiology and taxometry, and mathematics. Local officials can write for further information to:

Department of National Resources
Colorado State University
Fort Collins, Colorado

Watershed Management Department
University of Arizona
Tucson, Arizona

Local officials may also locate candidates by contacting both state and regional offices of federal agencies. Offices where inquiries may be made include the state offices of the Bureau of Land Management, Department of Interior (western states and Alaska only), the Soil Conservation Service, Department of Agriculture, and the regional offices of the Forest Service, Department of Agriculture.

Besides permanent staffing needs, temporary personnel needs may arise in connection with short term program projects. Staffing needs of this nature can most conveniently be filled by applying to state and federal agencies that have interests in the project. At the state level application can be made to the Soil Conservation Service through local conservation districts and to respective departments of natural resources. Federal agencies offering professional assistance include:

The access to this development site is washed out, clogging drainage systems in the area.

Department of Interior–Bureau of Indian Affairs

Department of Interior–United States Geological Survey

Department of Interior–FWPCA

Department of Interior–Bureau of Reclamation

Department of Agriculture–Soil Conservation Service

Applachian Regional Commission

(For further information regarding assistance programs administered by these agencies see the Chapter on Finance).

The third type of personnel to be considered when recruiting is nonprofessional or support personnel. Local agencies, which are part of the task force of agencies carrying out the control program, are normally able to provide support services without need for additional personnel. However, should additional personnel be needed, a most appropriate and growing source for eligible candidates is two-year college programs. Lab assistants, engineering aids, and inspection personnel can effectively be recruited from these programs. Local officials should contact local junior colleges or community colleges or two year agriculture and technical institutes.

SUMMARY

In most local jurisdictions, personnel exist that can be trained for performing the tasks involved in carrying out sedimentation control programs. The Soil Conservation Service, the Federal Water Pollution Control Administration, and respective state natural resources agencies can help in providing the needed training.

Where manpower needs require recruitment of personnel in addition to existing staff levels, intergovernmental working agreements with state and federal agencies operating at the local level, as well as hiring new personnel, may be considered. Conservation districts and water management agencies can provide needed technical manpower, as a form of technical assistance, for carryingout program operations.

chapter nine

Implementation and Control

Action can be taken at the local level to control sedimentation in non-agricultural areas. In combination with appropriate land-use planning, control measures that have been successfully employed in rural areas can be effectively applied to developing areas.

This chapter will attempt to outline some of the operational aspects of local soil erosion and sediment control programs. These operations will be discussed in five sections:

(1) review of development plans for appropriate erosion control measures
(2) application of control techniques
(3) major structural measures
(4) inspection and
(5) maintenance

REVIEW OF PROJECT PLANS

In order to achieve effective control over erosion and sediment, it is imperative that provisions for such control be incorporated in areawide, community, and project plans. Provisions for control should be made for at least the following development activities:

(1) Transportation facilities such as highways, railroads, streets and trails;
(2) Subdivisions or lot development;
(3) Industrial and commericial developments;
(4) Surface mining operations (e.g., sand, gravel, coal, rock, and soil);
(5) Service or recreational facilities such as shopping centers, schools, airports, and parks;
(6) Utilities, particularly underground installations;
(7) Water impoundments and waterway construction or improvement.

The necessary control measures for these activities should be specified in all development and construction project plans if they are to be implemented effectively during grading and construction operations. Review and approval of control measure specifications in project plans should be made by the local government prior to issuance of grading and construction permits. Review should determine whether project plans properly conform to areawide and community plans, to sedimentation control principles and to standards of good design and technique. Local agencies normally responsible for reviewing other aspects of project plans can provide the review necessary for control specifications.

For further information on areawide and community planning, see the Chapter on Planning For Sedimentation Control.

The review procedure should not be exclusively limited to private development projects. Public developments, such as transportation facilities, schools, parks, etc., also require

Instructions for Temporary Control Specifications *LOS ANGELES COUNTY, CALIFORNIA*

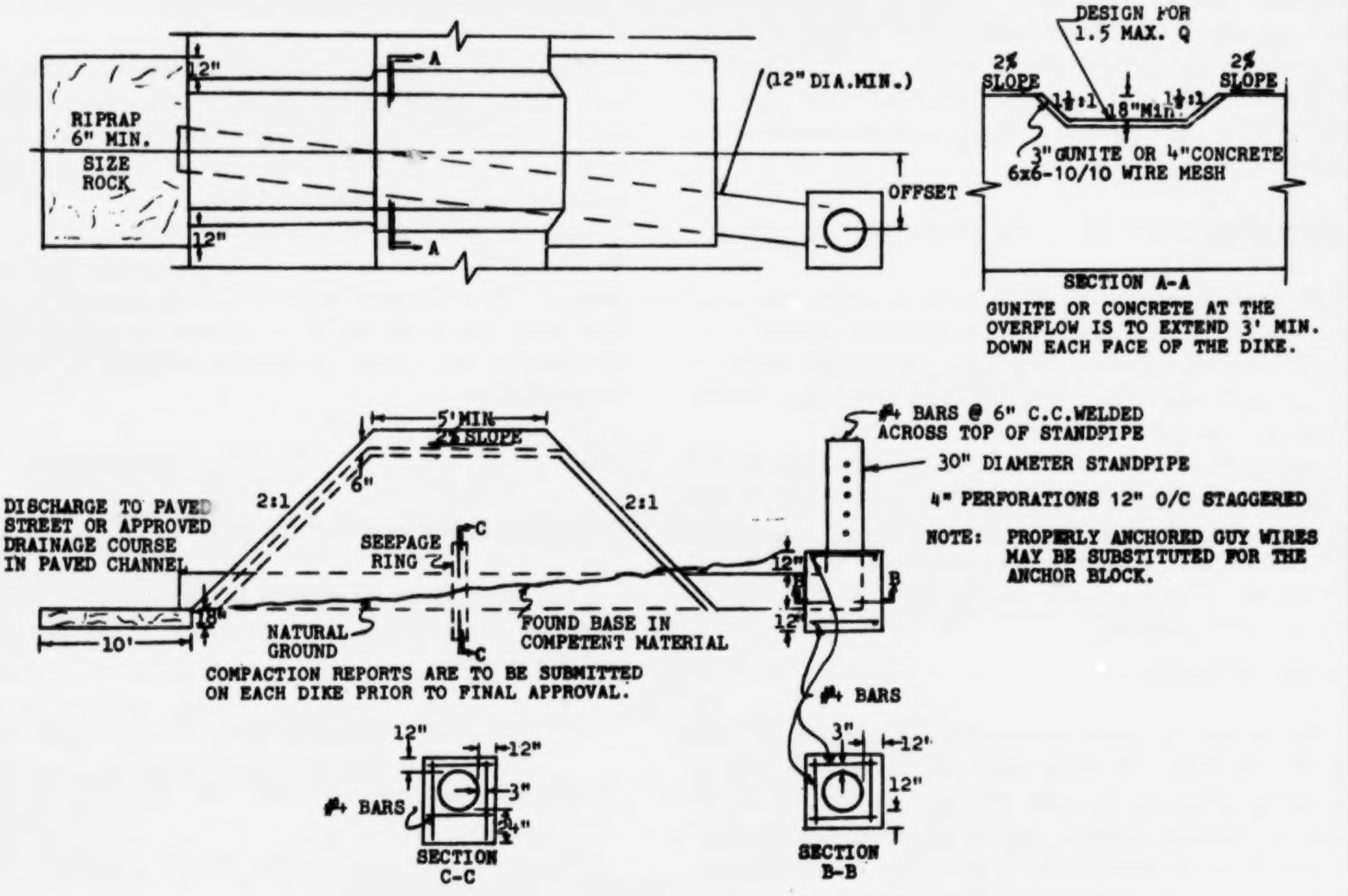
Grading for subdivisions in unincorporated areas of Los Angeles County is regulated under Chapter Ten of the Los Angeles County Building Code. *Section 7013 of these regulations requires as a form of* permanent *protection against erosion, the planting and irrigation of constructed earth slopes. If the earthmoving work occurs during the rainy season, (November 1-April 1) special requirements for* temporary *drainage and erosion control, including desilting facilities for storm waters leaving the site, are imposed by sections 7017 and 7018.*

An instruction sheet developed by the county and sent to developers to facilitate implementation of temporary *erosion control devices in accordance with sections 7017 and 7018 follows;*

1. Desilting facilities must be provided at all drainage outlets from the graded site. They must be detailed on the plans. If desilting basins are required, they must comply with the minimum standards below. Submit design and specific recommendations to cover the following:

   a. Basin volume based on gradient and nature of soils.
   b. Size of pipe and overflow (Overflow must be designed for 1.5 maximum Q).
   c. Height of standpipe.
   d. Dike requirements, minimum wall width, slope of wall, percent compaction, etc.

MINIMUM DESILTING BASIN STANDARD


RIPRAP
6" MIN.
SIZE
ROCK
12"
12"
A
A
(12" DIA.MIN.)
OFFSET
DESIGN FOR
1.5 MAX. Q
2% SLOPE
2% SLOPE
1½:1
1½:1
18" Min.
3" GUNITE OR 4" CONCRETE
6x6-10/10 WIRE MESH
SECTION A-A
5' MIN
2% SLOPE
6"
2:1
2:1
DISCHARGE TO PAVED
STREET OR APPROVED
DRAINAGE COURSE
IN PAVED CHANNEL
SEEPAGE
RING
C
C
18"
10'
NATURAL
GROUND
FOUND BASE IN
COMPETENT MATERIAL
12"
12"
B
B
#4 BARS @ 6" C.C. WELDED
ACROSS TOP OF STANDPIPE
30" DIAMETER STANDPIPE
4" PERFORATIONS 12" O/C STAGGERED
#4 BARS
12"
12"
3"
4"
#4 BARS
SECTION
C-C
3"
12"
12"
SECTION
B-B

GUNITE OR CONCRETE AT THE OVERFLOW IS TO EXTEND 3' MIN. DOWN EACH FACE OF THE DIKE.

NOTE: PROPERLY ANCHORED GUY WIRES MAY BE SUBSTITUTED FOR THE ANCHOR BLOCK.

COMPACTION REPORTS ARE TO BE SUBMITTED ON EACH DIKE PRIOR TO FINAL APPROVAL.

2. Place the following notes on the plans:

a. In case of emergency, call (responsible person) at (24-hour phone numbers).

b. The undersigned civil engineer will supervise erosion control work in accordance with the approved plans.

(Signature) __________________

c. A stand-by crew for emergency work shall be available at all times during the rainy season. Necessary materials shall be available on site and stockpiled at convenient locations to facilitate rapid construction of temporary devices when rain is imminent.

d. Devices shall not be moved or modified without the approval of the County Inspector.

e. All devices shown shall be in place at the end of each working day when the 5-day rain probability forecast exceeds 40%.

f. After a rainstorm, all silt and debris shall be removed from check berms and desilting basins and the basins pumped dry.

g. Fill slopes at the tract perimeter must drain away from the top of slope at the conclusion of each working day.

h. A guard will be posted on the site whenever the depth of water in any device exceeds two feet.

3. Indicate on the plan which streets will be paved and which drainage devices will be completed by November 1.

4. Placement of devices to reduce erosion damage within the tract is left to the discretion of the engineer. These devices, if any, must show on the plan because their presence will affect the required capacity of the desilting basin.

*5. Plans should be submitted to the office stamped on the front sheet along with a plan check fee of $*__________________

control measures as a part of their design and construction. When soliciting contract bids for public projects, local government contracting agencies should require contractors to submit needed control specifications as a part of their proposals. Contract agreements should be subject to review and approval of the specifications. Once entered into, the contract should specify that the private contractor will be responsible for, and must assume the extra cost of correcting erosion damage resulting from poor construction practices.

APPLICATION OF CONTROL TECHNIQUES

Soil erosion can be classified as being either natural or accelerated. Natural erosion is a geological process over which man has little or no control. Accelerated erosion is an increased rate of soil movement and destruction usually resulting from man's activities.

Sedimentation can be significantly reduced by controlling accelerated erosion. This section reviews the basic techniques that have been found to be generally effective in controlling accelerated erosion. The Chapter on Planning discusses the relationship of planning to sedimentation control.

Causes of Erosion

Soil erosion is caused primarily by rainfall and ensuing runoff. However, in many areas of the United States. erosion is generated by wind action. Both of these forces have one thing in common, namely they exert their greatest damage from *disturbed soils.* Specific factors affecting the erosion of soil may include the following:

(1) **Climate**–Amount, intensity, and frequency of rainfall, together with temperature, are the most important climatic factors affecting erosion.

(2) **Soil characteristics**–Degree of exposure and permeability in large part, determine the volume and intensity of runoff. Runoff occurs when rainfall exceeds infiltration capacity.

(3) **Length and degree of slope**–The intensity of water flow and extent of erosion are proportionate to slope length and gradient. The direction in which the slope faces is also significant. Dry south-facing is also significant. Dry south-facing slopes, with sparse vegetation and needing long periods for vegetation growth are less acceptable for development than moist north-facing slopes with adequate cover and reasonable growth periods.

(4) **Vegetation**–Reduces erosion potential through increasing infiltration capacity, through mechanically holding soil in place, and through protection of surface soil from wind.

(5) **Urban and suburban development**–Rate of runoff increases progressively with more extensive and intensive sidewalk paving, and roof and road construction. Increased areas of exposed surface and subsurface soils result from construction of highways, subdivision projects, industrial parks, etc.

Splashing raindrops displace particles of soil on inadequately protected land. Water running over such land and in downstream channels moves materials in proportion to water volume and velocity. Deposition of these materials occurs as the water slows down or spreads out.

Although wind erosion takes its heaviest toll from disturbed, fine textured soils during prolonged periods of drought, it is a potential threat to most types of soil at any time. Wind borne soil can fill a road ditch or a pond just as effectively as that carried by water; in addition, it polluted the atmosphere.

Sedimentation Control Principles

From these causes of erosion and deposition come the technical principles for control programs. Essentially, these principles include:

(1) fitting development plans to climatic factors, topography, soils and vegetative cover;

(2) reducing the area and the duration of exposed soils;

(3) retaining and protecting natural vegetation wherever feasible;

(4) covering disturbed soils with mulch or vegetation;

(5) mechanically retarding runoff and erosion, and sediment in runoff water and;

(6) providing effective accommodation for increased runoff caused by changed soil and surface conditions during and after development.

The application of these principles to development planning suggests an ideal situation wherein intensive development is restricted to level ground, avoiding steep topography and the more massive earth moving projects. Since development takes place on rolling ground, control measures are necessary. Where development proceeds in hillside areas, consideration should also be given to land slippage hazards and to construction designs that maximize open-space preservation. Attention must also be given to state and county road construction and maintenance operations, as well as to county and other public building projects.

Control Measures and Practices

Sedimentation control practices or measures, either singularly or in combination, can be applied to both public and private developments with effective results at moderate cost. A brief description of some of these follows.

Non-critical area vegetation. Non-critical areas are those of good soils on moderate slopes. The establishment and maintenance of good vegetative cover in these areas is relatively simple as compared to "critical areas." Non-critical areas can usually be stabilized by utilizing the standard plants and establishment techniques recommended by local agencies or landscaping services. Soil tests should be made as a basis for adding the plant food necessary for plant establishment and maintenance.

Critical area vegetation stabilization. Critical areas are those in which cutting, filling, and grading soils with heavy equipment often result in the exposure of soils and subsoils. Certain conditions resulting from such exposure, such as acidity, low fertility, compaction, or dryness or wetness which are unfavorable to plant growth often prevails. Excessively long slopes and steep grades are often encountered or created. Water disposal structures are normally subjected to hydraulic forces requiring both special establishment techniques and grasses which have high resistance to scouring. However, plants and techniques are available to provide both temporary and permanent protective cover on these difficult sites. These are

(1) **Temporary measures**–Heavy grading or construction of cuts and fills is often carried out in several stages interrupted by lengthy periods during which the land lies idle and is subject to heavy erosion. Similarly, final grading or filling may be completed during a season not favorable to the immediate establishment of permanent vegetative cover. Such sites can be temporarily stablilized by seeding fast growing annuals such as rye, ryegrass, sudan grass, or other locally adopted vegetation which provide quick protection yet can be worked into the soil when the site is prepared for final seeding of a permanent species.

An alternative method is the application of mulch for immediate protection. Where final grading is not completed, mulch can either be removed or worked into the soil after it has afforded protection while the area lay idle. Areas brought to final grade during midsummer or winter can be mulched immediately, and they may be successfully overseeded at the proper time with a number of permanent grass and legume species. Materials that may be used as a mulch include straw, fiberglass, wood chips or fiber, and mechnically sprayed asphalt wood fiber slurry, and plastics or other synthetics.

(2) **Permanent Vegetation**–For both sodding and seeding, there is a fairly wide choice of grasses, legumes, and other plants for use on critical areas. The final choice of species should be determined by weighing such factors as adaptability, use, aesthetic requirements, a degree of maintenance that can be expected and other special considerations. Plants should be selected that will provide long-lived stabilization with little subsequent management where a "manicured" look is not required. Some species provide excellent protection against scour in waterways and outlets but most require periodic mowing and fertilization. Where a reasonably high level of management can be expected, the choice of plants is broader. Often, techniques of seedbed preparation and establishment are as important as the selection of the species.

Agronomists with a technical knowledge of the area's soils and plants can be helpful in suggesting the methods and kinds of temporary and permanent treatments needed. Local offices of the Soil Conservation Service have, in cooperation with state highway departments, developed new methods and hardy strains of grasses and other plants for resisting erosion.

Diversions. A diversion consists of a channel or ditch and ridge constructed across a sloping land surface on the contour, or with predetermined grades to intercept and divert surface runoff before it gains sufficient volume and velocity to create harmful erosion. The number of diversions and the physical extent and spacing is dependent upon the land slope, soil and runoff. The water is collected and conveyed laterally along the diversion at slow velocity and discharged into a protected area or outlet channel.

Diversions should be especially considered for earth cut and fill slopes created by highway construction or other heavy grading. Severe erosion of earth slopes is caused from storm water concentrations moving along the bottom edge or down the face of unprotected embankments or other slopes. Both temporary and permenent diversions should be placed at the top and along the base of cut and fill slopes as needed. Other measures can be applied directly to the face of the slope (e.g. bench terrace; enclosed drainage systems; and seeding, sodding and mulching) without being undermined by concentrations of storm runoff.

Bench terraces. Bench terraces are relatively flat surfaces constructed on sloping land or embankments to planned dimensions and grades. Bench terraces are applied along the contour with the length and width controlled by the natural terrain and the required erosion limitations.

Contour benches may be installed across a slope and may be designed for widths which will permit construction of a row or tier of housing units.

Outlet channels. This measures consist of the construction of designed channels for the disposal of storm runoff from diversions, bench terraces and other structures. The design is based on the runoff from predicted storm events and includes the vegetative or structural measures required to protect the channel from scouring and erosion.

Water stabilization structures. Waterway erosion control methods include structural devices to dissipate the energy of flowing water by holding the waterway slopes and velocities within non-scouring limits. Drop structures, and concrete or other lining could be utilized in an open waterway to control water velocity.

Bank erosion structures. The control of bank erosion in main stream channel can be accomplished in various ways. Methods commonly used include riprap, rock cribs, groins, jetties fencing, piling, etc. The purpose of these measures is to install a barrier that will withstand the erosive forces exerted by flowing water or to create a bank roughness that will reduce the erosive power by dissipating energy of the water as it moves along the bank line.

Stream channel construction. It is often impractical to attempt control of an existing meandering channel. In this case, channel straightening, realignment, or the construction of a new channel to designed cross-section and grade is necessary. In doing this, however, the danger exists of creating a new erosion cycle. The design must include considerations regarding the stability of the bed and banks of the proposed channel under the predicted runoff conditions.

In highway construction, surface channels, natural or man-made, are ususally the most economical means of collecting and disposing of runoff. Such man-made channels, however, if not properly designed may cause serious erosion problems. A primary design principle is to construct channels with sloping sides and wide bottoms.

Protective linings for channels can be very expensive. Special effort should be made to develop the necessary erosion protection according to topographical and hydrological features at the lowest cost. Channel design and protective treatments are discussed in Hydraulic Design Series No. 4, "Design of Roadside Drainage Channels," published by the Bureau of Public Roads and available from the Government Printing Office. Field manuals and publications of the Soil Conservation Service also provide valuable channel design information.

Sediment basins The construction of an earth fill type dam downstream from a development area serves to regulate runoff and trap sediment. The sediment can be removed mechanically as the storage space behind the dam becomes filled, or sufficient space may be built into the structure to provide storage for its useful life. The whole structure can be removed after stability is reached in the development area or it can be retained and maintained to enhance the area.

Dams trapping sediment must be carefully located and designed because failure during a major flood could have consequences far greater than most sediment problems created by development construction. Health and safety hazards, methods and locations for disposing of the trapped sediment and the future flood potential must also be evaluated.

MAJOR DRAINAGE CONTROL

Storm Drainage Systems

Increased runoff from the impermeable surfaces of suburban areas may place excessive stress on drainage channels. In such cases, channels may become scoured or widened, causing unnecessary deterioration of the channels and their surrounding land area with corresponding increases in maintenance expenses.

Control over this problem is possible by installation of a storm drainage system. The purpose of such a system is to control the velocity of storm runoff thereby decreasing the scouring damage to downstream areas. Such control is achieved by trapping and releasing excess storm water at preferred rates of flow.

However, if the controlled water contains sediment, the storm drainage system may act as a conveyance vehicle for sediment yields that will accumulate at downstream points where water flow widens and slows. Unless such conditions are compensated for, the storm drainage system will not solve the sediment problem but instead, will only relocate it.

Major structural measures.

As a part of areawide (or drainage-wide) water management, erosion and sediment control may call for major capital improvements that also serve other objectives of water management, e.g., flood control, recreation, and water supply and storage. Application of these measures will depend on:

(1) the multiple objectives to be the achieved in a drainage or subdrainage area and
(2) evaluation of each measure in terms of costs versus benefits when applied toward achievement of these objectives.

Major improvements include flood and sediment detention structures, debris basins, storm sewers, open channel lingings, reservoirs, irrigation systems, and drop structures.

Recently, high velocity conveyance channels have been used to control flood flows through developed areas. In addition to flood control, these devices reduce the necessary channel width and eliminate a channel erosion problem. The procedure is to construct a lined channel, usually concrete, designed for sufficient depth to carry critical flows. Critical flow is defined as the state of flow at which the specific energy is a minimum for a given discharge.

Since many major structural measures are constructed in populated areas, safety must be considered in their design. Generally, landscaping and drainage design are compatible with both erosion control and safety.

INSPECTION

A crucial element of a sedimentation control program is adequate on-going field inspection of construction and development operations. Inspection provides the mechanism for evaluating compliance of developers with approved project plans. An examination of existing programs indicate that sedimentation control inspection activities can effectively be phased into existing local government inspection agencies.

Since soil erosion and sediment can occur whenever (development takes place) *public*, as well as private, development projects should not be overlooked when inspecting for needed erosion control measures. Inspection for needed conservation measures during the construction of public projects can be effectively phased into and carried out at the same time normal inspection requirements are performed. When the project is to be carried out by a private contractor, the plans, specifications, and special provisions of the contract should be explicit in showing the location, scope, time of application, and design of the control measures to be established. Inspection personnel should be able to read and understand these plans, specifications, and provisions, and to evaluate the contractor's compliance with them during on-site inspections.

Specific concerns of inspection personnel during on-site inspection of both private and public development projects should include the following guidelines.

(1) Sufficient erosion control measures should be practiced during the initial grading for development projects.

(2) Permanent soil protection and drainage facilities, particularly intercepting channels and similar controls that will divert runoff from work areas and unprotected soil, should be completed as early as practicable.

(3) Temporary protection may include fiber mats, plastic, straw, dust palliatives, and fast-growing grasses that may be required in some areas to protect against erosion on newly constructed slopes.

(4) Stockpile soils separately, according to type to protect good top soil for use in restoring distrubed vegetation. Protect stockpiles with mulch. In critical areas, a course fiber netting will hold the mulch in place. When stockpiles must remain for an extended period of time before final grading can be done, establish plant cover of small grains, grass, or legumes, or combinations of all three.

(5) During construction, carefully inspect partically completed drainage structures to prevent unnecessary erosion from their construction and to avoid damage to these structures.

(6) Fording of streams with equipment should be kept to a minimum and where frequent crossings are expected, temporary bridges or culverts should be constructed if the sediment produced may have adverse effects on aquatic life, navigation, storm drainage, or the quality or quantity of water supplies.

(7) Work roads constructed within a development project area should include sufficient erosion control measures during their use, as well, as upon their restoration.

(8) Where stream channel changes are found necessary during a development project diversion dikes should be considered to

Drop-Inlet Structures in Washington County *PAPILLION CREEK WATERSHED, NEBRASKA*

The Papillion Creek Watershed consists of 245,800 acres in Sarpy, Douglas and Washington Counties in Eastern Nebraska. The Watershed also includes a large part of the Omaha metropolitan area. Although suburbanization is occuring .within Omaha and within smaller communities, the largest portion of the watersed area remains in agricultural use. Topography in the area varies from nearly level bottomlands to uplands with moderate to steep slopes.

Flooding, erosion, and sediment are major problems in the area. Erosion has become a particularly serious problem in the upland areas where slopes consisting of highly erodible loess soils are quickly gullied by frequent hard-hitting thunderstorms. It is not unusual for steep gullies to form, or for old gullies to greatly deteriorate after only one intense storm.

Land in Washington County, the northernmost county in the watershed, is particularly suseptible to gully erosion. In particular, constantly widening gullies proved to be a dangerous and costly highway menance. During storms, eroding gullies would often cause damage to bridges by undermining the abutments. Such bridges were unsafe, required frequent repairs, and sometimes collapsed altogether.

As early as 1935, leaders in Washington County initiated a program to replace these expensive span-type bridges with "drop-inlet structures" which have proven far less expensive, are far more durable, and also help to prevent soil erosion. The economical drop-inlet device consists of a simple structure which allows bridges to be replaced by earth works, similar to a dam, upon which the road passes. A pipe system then permits water to pass through the earth work at a controlled rate. The drop-inlet structure thereby serves as both a bridge and as a method of controlling gully erosion simultaneously.

Over 200 drop-inlet structures have been installed in Washington County. Local officials estimate that these structures have saved the county well over a million dollars. One such structure was installed at a cost of $19,000 to replace a 120 foot bridge which has collapsed. It was estimated that it would have cost $40,000 or more to replace the bridge, with no assurance that it would not collapse again in the future. None of the drop-inlet structures have failed or required extensive maintenance.

On a national level, drop-inlet structures are being used increasingly, and for many purposes. They are useful in preventing erosion on construction sites, help to control water drainage in recreation areas, and they are used to control drainage along many modern highways.

avoid sediment problems when such changes are being made and stabilized.

(9) Embankment slopes created during construction that encroach on stream channel should be adequately protected against erosion. Where practicable, a protective area of vegetational cover should be left or estabished between the embankment and adjacent stream channels.

(10) In areas being used for borrow pits and waste disposal, control of drainage water should include measures to control erosion and seepage keep sediment and from entering streams. Diversion channels, dikes, and sediment traps may be used for this purpose. Good topsoil from the borrow pit area should be saved for use in restoring the excavated area. Final restoration of borrow or waste disposal areas should include grading, establishment of vegetative cover, or other necessary treatments that will blend the area into the surrounding landscape. The restored area should be well drained unless approval is given to convert the pit area into lakes for fish and wildlife, recreation, stock water, or irrigation.

(11) In areas where a severe fire hazard exists, fire extinguishing equipment should be maintained on the construction site for the prevention of brush and grass fires since burned over areas are highly vulnerable to erosion.

(12) Construction operations which violate local fire regulations or represent a fire hazard should be reported so that official action can be taken to suspend such operations.

MAINTENANCE

Inspection of drainage and erosion control measures should commence shortly after construction is completed to correct any deficencies before they grow into major problems. Experts in soil conservation, agronomy and drainage should be employed to recommend appropriate remedial measures. Deficiencies in design or construction practices should be reported to the appropriate local government agency so that provisions can be developed to prevent similar deficiencies in future projects. Continued coordination between local planning, engineering, and maintenance departments is essential.

Training workshops should be conducted for maintenance personnel and should include instruction in the methods of making inspections, managing vegetational covers and plants, and preventing and correcting erosion. Such workshops should be held periodically to maintain the proper orientation among personnel toward the problem and to represent new and developing erosion and sediment control techniques.

Maintenance records should give sufficient detail to allow analysis of maintenance problems. Fruitful analysis can suggest changes in the design and construction that may reduce soil erosion and sediment, as well as reduce maintenance costs.

SUMMARY

The operations of a sedimentation control program begin the incorporation of necessary conservation provisions in development and construction plans. Ideally, planning for erosion and sediment control should be for entire drainage areas such as water basins or watersheds. Erosion control specifications related to individual development projects need to be included in overall project plans. To insure the proper provision and scope of these specifications, project plans should be subject to review and approval prior to grading and construction activities.

During construction and excavating operations, on-site inspections by county personnel is necessary to ensure compliance with approved plans. At completion of construction, but prior to acceptance, inspection personnel should inspect project sites for needed remedial measures that may be required.

Action Guide for Erosion and Sediment Control

LOCAL GOVERNMENT'S ROLE

Environmental quality has deteriorated so seriously that local governments now have only two choices: to conduct effective environmental control programs at the local level, or to pass local responsibility and authority for control programs to state and federal levels by default. Local officials should provide leadership to their departments and to their communities in maintaining a clean environment and managing local resources.

Very few local governments have accepted responsibility for developing sedimentation control programs, and consequently, experience with erosion and sediment control in urban areas has not been extensive. However, citizens are beginning to demand that community resources, including soil and water, be properly managed. Since the county is an areawide unit of government, serving urban, suburban, and rural citizens, county officials are in an excellent position to respond to the public's demand by establishing effective areawide sedimentation control programs.

The guidebook is based on 10 months of research, including on-site visits to local sedimentation control programs across the nation, to state level control operations, and to various federal agencies. In addition, the guidebook is based on the recommendation made by 200 experts in water quality and soil conservation at the National Conference on Sediment Control, held in Washington, D.C., September, 1969.

This chapter represents a synthesis of sedimentation control concepts, principles, and techniques, which can be converted into general action plans by local, state and federal levels of government.

WHAT SHOULD LOCAL GOVERNMENT DO?

Local elected officials can establish a sedimentation control program by taking the following basic steps:

I. Appoint a Task Force.

Local elected officials should begin their sediment control program by appointing a sediment control task force to develop recommendations for the program.

In most existing urban programs, this task force was made up of individuals from the planning commissions, water and sewer agencies, home builders associations, soil conservation districts, professional engineers associations, contractors groups, U.S. Soil Conservation Service, State Department of Water Resources, and others concerned with the problem.

II. Establish Task Force Objectives. The Task Force should fulfill the following basic objectives:

(1) Determine through physical and demographical studies the nature and extent of the local sedimentation problems.

(2) Determine existing erosion and sediment control practices exercised by local public agencies, and private developers contractors.

(3) Determine what state and local laws exist regarding water pollution and land use.

(4) Decide what should be done by local governments, areawide government, and private industry, and how they can best cooperate in carrying out the program.

(5) Insure that development and construction activities do not result in environmental pollution.

III. How to Proceed

(1) See that the program is premised on providing control for the totality for every watershed lying, whole or in part, within local jurisdictions.

Frequently, the county is the areawide unit which meets this requirement. Where a single county is not large enough to solve the areawide sediment control problem, the multi-county approach may be best. In some large metropolitan areas where erosion and sediment problems cross jurisdictional boundaries, councils of government may offer an excellent vehicle to stimulate local officials to think, plan, and act in broad terms of mutual problem areas and to encourage jurisdictions to effect a mutually complementary system for sedimentation control.

Sometimes special purpose governments may be used because of their expertise in erosion control. If a special purpose government must be used, it is better to work through existing special purpose governments (where possible) rather than to create new ones.

Jurisdictions can cooperate through various techniques: by jointly performing some or all aspects of the control program; by contracting between cities and counties; and by transferring responsibility for a function from one level of government to another. Through these and other techniques, local governments can take advantage of economies of scale to implement an areawide control program.

(2) Determine whether necessary legal authority has been delegated by the state. If state enabling legislation is not adequate, officials should do as much as possible within existing law and decide what changes are needed. Then, they can work through their state association of counties and other interested groups for passage of comprehensive sedimentation control enabling legislation.

The legal basis for local governments to control land use is state enabling law. Without this enabling authority, local governments cannot acquire land, develop facilities, or spend public funds to regulate and control erosion and sediment. To ensure that local governments have the necessary powers, legislation should allow political subdivisions to manage sediment in coordination with other environmental protection programs.

Home rule cities and counties must closely examine their charters to be sure they have the authority to plan, regulate, and operate a sedimentation control program.

State legislation should give local government authority to:

(a) acquire land, buildings, and facilities by purchase, lease, eminent domain, and donation;
(b) plan and zone for the protection of watersheds and natural drainage courses;
(c) adopt and enforce necessary ordinances, rules, and regulations;
(d) use various sources of revenue such as bonds, taxes, general appropriations, fees and service charges, and state and federal assistance programs;
(e) make intergovernment agreements and contracts;
(f) regulate private contractors and developers through the issuance of permits and licenses;
(g) prohibit any type of environmental pollution.

(3) Require that soil and water conservation considerations be incorporated incorporated in community plans. Plans may be prepared by an interagency committee of interested departments, by a single department, by a consultant, or by a combination of local departments and consultants.

Community plans should include:

(a) data on population, land use, transporation, and public facilities and utilities;
(b) considerations of the climate, topotraphy, geology, and related factors, with the technical assistance of any needed specialists so that development and construction activities are not detrimental to the community's land and water resources;
(c) presentation and evaluation of feasible immediate and long-range solutions.

(4) Require that development and construction project plans be prepared in coordination with community plans.

Project plans should include specifications for needed erosion and sediment control measures.

(5) To prepare the best possible plans and achieve implementation, elected officials should:

(a) solicit cooperation on an areawide basis from city and county planners, public works agencies, health officers, engineers, soil conservation districts, other appropriate departments, and interested citizens;
(b) plan to inform the public about the need for a comprehensive erosion and sediment control program;
(c) provide leadership and initiative to ensure acceptance and implementation of the plan.

(6) Decide what type of organization is needed and assign operating responsibilities.

No one organizational pattern for erosion and sediment control can be said to be best. Local conditions and custom will determine which one or combination of agencies can be assigned responsibility for administration of the control program. The sedimentation control agency or agencies must be responsible to elected officials of general purpose governments. Regardless of organization, the following functions must be performed: policy making; public information; budgeting; planning and review; drafting, adoption, and enforcement of standards; and operation of the system.

The main criterion for determining what place a sedimentation control program should have in the orgainzational structure of a local government that existing agencies should be used to carry out the program rather than creating a new agency.

(7) Obtain technical information on current community plans, and the community's geological, topological, and soil conditions.

The program should stress the physical limitations of every development and construction site. Also, this should be considered in all land-use decisions. Basic principles would include the development of large areas in small, workable increments, the holding of exposure time to a minimum and adapting site plans to the natural topography.

Timely installation or structures, storm drains, streets, and gutters is necessary plus applicable conservation measures, such as the use of mulch (as a temporary cover), temporary seedings, early installations of permanent vegetation, and the use of temporary structures, terraces, waterways, and debris basins.

(8) Prepare a financial plan and capital budget so that both immediate operating expenditures and long-range capital financing needs are provided for.

Although much of the cost for providing sedimenation control will be assumed by private industry (i.e., developers and builders), local government will still be responsible for providing control related to public improvements and for their maintenance, e.g., parks, reservoirs, open channel linings, etc.

Since the system must be financed within the constraints of state laws and local charters these should be thoroughly examined during the planning process. Local governments can finance the system when necessary following methods: taxes, bond issues, loans, and/or service charges. The local capital improvement budget should schedule the financing of all necessary control facilities and equipment.

If the sedimentation control program is operated on an areawide basis, economies of operation will often benefit each jurisdiction.

(9) Find out what federal, state, and private technical and financial assistance is available and take advantage of it.

Technical assistance from federal state, and private sources is available to local governments to develop measures related to sediment control. On the federal level, the primary sources of financial and technical assistance are the Department of Agriculture the Department of the Interior and Department of Housing and Urban Development. Imaginative use of assistance from other federal agencies may provide help for local sedimentation control.

Many states provide technical assistance for soil and water conservation through conservation districts and other special purpose governments such as flood control districts. While financial assistance is currently limited, recent appropriation trends indicate a growing response to environmental needs.

The home building industry, universities, professional societies and private organizations also can provide information and assistance.

(10) Direct the program's agencies to respond quickly to all citizen complaints and conduct a continuing educational program to inform the public about the need for land use control in relation to water pollution control.

(11) Use as many public information tools as possible to reach citizens.

Among these tools are meetings at which slides and films are shown; creation of events such as "go-see" trips; speakers bureaus; brochures and flyers; radio, T.V., newspapers, and newsletter coverage and announcements; exhibits; and communications media endorsement.

(12) Employ a qualified committee of representatives from public agencies, citizens groups, and industry to periodically review, evaluate, and report on the effectiveness of the program.

(13) Survey recruitment needs. Where they exist, solicit personnel from other levels of government, professional organizations, and universities. Also, technical manpower may, in many cases, be involved in the program as a form of technical assistance from other local, state and federal government agencies.

(14) In-house training will be needed for program personnel, especially for planners, and regulatory and maintenance personnel. It should be noted that during the development of these ordinances and the program, local soil conservation districts are available to work with local public agencies, consultants, and engineers in the design and installation of erosion control practices.

IV. Make the Sedimentation Control Program Developed by the Task Force State Local Government Policy.

Charge local government department heads with responsibility for developing policies and procedures designed to implement the program, and solicit the voluntary cooperation of the building industry.

Sedimentation control programs to date that appear to work best are those that initially evolve from some type of voluntary action. Urban sedimentation control is a new field and all concerned need an opportunity to test their ideas. Where developers, planners and conservationists have an opportunity to cooperate voluntarily on erosion control projects, a solid foundation for future regulatory program is provided for.

V. Make Sediment Control Mandatory Through Adoption of an Ordinance or Land-Use Regulations.

The responsibility for developing the ordinance or land-use regulation can best be assumed by the Task Force. Also Task Force members know the existing regulations and they have developed the basic guidelines for the voluntary program.

The ordinance or land-use regulation, when developed, would set the local standards. They should be conceptual in scope; flexible in methods; positive in direction; prohibitive of any type of land or water pollution; and above all, they must be clearly understandable. They should be designed to control the occasional irresponsible developer.

The ordinance or regulation should designate the local agencies to be responsible for enforcing the standards, e.g., plan, review and inspection.

WHAT SHOULD STATE GOVERNMENT DO?

I. Provide comprehensive state enabling legislation to permit counties to manage soil and water resources. Also, counties should be permitted and encouraged to contract with internal municipalities and other counties to develop areawide sedimentation control programs.

Develop clear state guidelines with regard to sedimentation standards. Water quality standards, based on federal guidelines (Federal Water Pollution Control Act of 1956, the Water Quality Act of 1965, and the Clean Water Restoration Act of 1966) have been adopted by all 50 states. States should ensure that criteria for sedimentation control be included in these standards.

III. Provide financial and technical assistance to local sedimentation control programs. Such assistance can be delivered through state agencies, should help local programs conduct watershed research, conduct soils studies, and provide major capital improvements, etc.

IV. Develop and execute an information distribution program. Local governments and their agencies, planning commissions, soil conservation district personnel, etc., need to be informed on state laws and their interpretation, what state assistance is available, state policy guidelines, state planning programs and other state activities.

V. Offer traning to local government and private industry in sedimentation control techniques and principles.

VI. Develop and enforce a state sedimentation control program to help control erosion and sediment on all state projects and activities including highway construction and maintenance, and state building projects.

WHAT SHOULD THE FEDERAL GOVERNMENT DO?

I. Help to promote national recognition of urban erosion and sediment as constituting a major threat to environmental quality.

II. Continue to contribute to technical and non-technical research programs related to all aspects of urban erosion and sediment problems.

III. Continue and improve upon financial and technical assistance programs for state and local governments.

IV. Develop and enforce a federal sedimentation policy to help control erosion and sediment on all federal projects, and federally sponsored projects, including federal buildings, federal highways, and on all federal lands and waters. Sedimentation control policy should be enforcible on all appropriate federal contracts, whether carried out by public or private agencies.

APPENDIX

Economic Development

North Eastern Area
EDA Area Office, 157 High Street
Portland, Maine 04101
(Connecticut, Maine, Massachusetts,
New Hampshire, New York, Rhode
Island, Vermont

Mid Atlantic Area
EDA Area Office, 19 North Main
Street, Wilkes-Barre, Pa. 18701
(Delaware, Maryland, New Jersey,
Pennsylvania, Puerto Rio)

Mid Eastern Area
EDA Area Office, 517 Ninth Street
Huntington, W. Va. 25701
(Kentucky, North Carolina, Ohio,
Virginia, West Virginia)

South Eastern Area
EDA Area Office, 904 Bob Wallace
Avenue, Huntsville, Ala. 35801
(Alabama, Florida, Georgia,
Mississippi, South Carolina, Tennessee)

North Central Area
EDA Area Office, 200 West Superior
Street, Duluth, Minn 55802
(Illinois, Indiana, Iowa, Michigan,
Minnesota, Missouri, Nebraska,
North Dakota, South Dakota, Wisconsin)

South Western Area
EDA Area Office, 702 Colorado
Street, Austin, Tex. 78701
(Arizona, Arkansas, Colorado,
Kansas, Louisiana, New Mexico,
Nevada, Oklahoma, Texas, Utah,
Wyoming)

Western Area
EDA Area Office, 415 First Avenue
North, Seattle, Wash. 98109
(Alaska, American Samoa, Calif.
Guam, Hawaii, Idaho, Montana, Oregon,
Washington)

Department of Housing and Urban Development

Region
26 Federal Plaza, New York, N.Y.
10007 (Connecticut, Maine,
Massachusetts,
New Hampshire, New York, Rhode Island
Vermont)

Region II
Widener Building, 1339 Chestnut
Street, Philadelphia, Pa. 19107 (Delaware,
District of Columbia, Maryland, New
Jersey, Pennsylvania Virginia, West Virginia)

Region III
Peachtree-Seventh Building, Atlanta,
Ga. 30323 (Alabama, Florida, Georgia,
Kentucky, Mississippi, North Carolina,
South Carolina, Tennessee)

Region IV
360 North Michigan Avenue, Chicago,
Ill. 60601 (Illinois, Indiana, Iowa,
Michigan, Minnesota, Nebraska, North
Dakota, Ohio, South Dakota, Wisconsin)

Region V
Federal Office Building, 819 Taylor
Street, Fort Worth, Tex. 76102
(Arkansas, Colorado, Kansas, Louisiana,
Missouri, New Mexico, Oklahoma, Texas,)

Region VI
450 Golden Gate Avenue, Post
Office Box 36003, San Francisco,
Calif. 94102 (Alaska, Arizona,
California, Hawaii, Idaho,
Montana, Nevada, Oregon, Utah,
Washington, Wyoming, Guam)
Region VII
Post Office Box 3869 GPO, San
Juan, P.R. 00936 (Puerto Rico,
Virgin Islands)

BUREAU OF OUTDOOR RECREATION

Northeast
128 North Broad Street
Philadelphia, Pa. 19107
Southwest
810 New Walton Building
Atlanta, Ga. 30303

Lake Central
3853 Research Park Drive
Ann Arbor, Mich. 48104

Mid-Continent
Denver Federal Center
Building 14
Denver Colo. 80225

Pacific Northwest
U.S. Courthouse,
Seattle, Wash. 98104

Pacific Southwest
450 Golden Gate Avenue,
San Francisco, Calif. 94102

DEPARTMENT OF TRANSPORTATION

Alaska Region
632 Sixth Avenue,
Anchorage, Alaska 99501

Western Region
Post Office Box 92007
World Way Postal Center
Los Angeles, Calif. 90009

Pacific Region
Post Office Box 4009
Honolulu, Hawaii 96812

Southern Region
Post Office Box 20636
Atlanta, Ga. 30320

Central Region
601 12th Street
Kansas City, Mo. 64106

Eastern Region
JFK International Airport
N.Y. 11430

Southwest Region
Post Office Box 1689
Fort Worth, Tex. 76101

Interstate Commissions

Bi-State Development Agency
Suite 619 Paul Brown Bldg.
St. Louis, Missouri 63101
Illinois
Missouri

Interstate Sanitation Commission
10 Columbus Circle
New York, New York 10019
Connecticut
New Jersey
New York

Ohio River Valley Water Sanitation Commission
414 Walnut Street
Cincinnati, Ohio 45202
Illinois   Ohio
Indiana   Pennsylvania
Kentucky   Virginia
New York   West Virginia

Delaware River Basin Commission
25 Scotch Road, P.O. Box 360
Trenton, New Jersey 08603
Delaware
New Jersey
New York
Pennsylvania

Klamath River Compact Commission
P. O. Box 388
Sacramento, California 95802
California
Oregon

Tennessee River Basin Water Pollution Control Commission
Central Services Building
Nashville, Tennessee 37219
Kentucky
Mississippi
Tennessee

Interstate Commission on the Potomac River Basin
Transportation Building
815-17th Street, N.W.
Washington, D. C. 20006
District of Columbia
Maryland
Pennsylvania
Virginia
West Virginia

New England Interstate Water Pollution Control Commission
73 Tremont Street
Boston, Massachusetts 02108
Connecticut   New York
Maine   Rhode Island
Massachusetts   Vermont
New Hampshire

State Committee, Commissions, Boards and Councils

Alabama Soil and Water Conservation Committee State Office Bldg., Montgomery 36104

Division of Agriculture Alaska Department of Natural Resources P.O. Box 824, Palmer 99645

Arizona State Division of Soil Conservation 400 Arizona State Office Bldg., Phoenix 85007

Arkansas Soil & Water Conservation Commission State Capitol, Little Rock 72201

California State Soil Conservation Commission 1416 Ninth St., Sacramento 95814

Colorado State Soil Conservation Board 1845 Sherman St., Denver 80203

Connecticut State Soil Conservation Advisory Committee State Office Building Hartford 06115

Delaware Soil and Water Conservation Commission P.O. Box 567, Georgetown 19947

Florida State Soil and Water Conservation Board P.O. Drawer E, Gainesville 32601

Georgia State Soil & Water Conservation Committee 320 Ag. Extension Bldg. Athens 30601

Hawaii Board of Land & Natural Resources Box 621, Honolulu 96809

Idaho State Soil Conservation Commission Statehouse, Boise 83707

Illinois Division of Soil and Water Conservation Fairgrounds, Springfield 62706

Indiana State Soil and Water Conservation Committee AES Bldg. Purdue Univ., West Lafayettee 47907

Iowa State Soil Conservation Committee Grimes State Office Bldg. Des Moines 50319

Kansas State Soil Conservation Committee State Office Bldg., Topeka 66612

Kentucky Soil & Water Conservation Commission 729 Bluegrass Ave., Frankfort 40601

Louisiana State Soil and Water Conservation Committee P.O. Drawer CS, LSU, Baton Rouge 70803

Maine State Soil and Water Conservation Committee State House, Augusta 04330

Massachusetts State Committee for Conservation of Soil, Water and Related Resources 100 Cambridge St., State Office Building. Boston 02202

Michigan State Soil Conservation Committee National Res. Bldg. MSA, E. Lansing 48823

Minnesota State Soil and Water Conservation Commission 311 N. Hall St. Paul Campus, U. of Minn. St Paul 55101

Minnesota State Soil and Water Conservation Committee Carhage 39051

Missouri State Soil and Water District Commission 705 Hitt., U of Mo., Columbia 65201

Montana State Soil Conservation Committee Montana Tech, Buttee 59701

Nebraska Soil and Water Conservation Commission Box 94725 State House Sta., Lincoln 68509

Nevada State Soil Conservation Committee Nye Bldg. 201 S. Fall St., Carson City 89701

New Hampshire State Soil Conservation Committee Univ. of N.H., Durham 03824

New Jersey State Soil Conservation Committee P.O. Box 1888, Trenton 08625

New Mexico State and Water Conservation Committee Capitol Bldg., Santa Fe 87501

New York State Soil and Water Conservation Committee Emerson Hall, Cornell Univ. Ithaca 14850

North Carolina State Soil and Water Conservation Committee Williams Hall, NC State U., Raleigh 27607

North Dakota State Soil Conservation Committee State Capitol, Bismarck 58501

Ohio Soil & Water Conservation Committee 1827 Neil Ave., Columbus 43201

Oklahoma State Soil Conservation Board 114 State Capitol, Oklahoma City 73105

Oregon State Soil and Water Conservstion Committee Ag. Bldg. Salem 93701

Pennsylvania State Soil and Water Conservation Commission 2301 N. Cameron St., Harrisburg 17120

Soil Conservation Committee of Puerto Rico Box AR, Rio Piedras 00928

Rhode Island State Soil and Water Conservation Committee RD 2, E Main Rd, Middleton 02842

State of South Carolina Soil and Water Conservation Committee 1411 Barwell St., Columbia 29201

South Dakota State Conservation Commission State Capitol, Pierre 57501

Tennessee State Soil Conservation District Committee P.O. Box 1071, Knoxville 37901

Texas State Soil and Water Conservation Board 1018 First National Bldg., Temple 76501

Utah State Soil Conservation Committee State Captiol Bldg., Salt Lake City 84114

Vermont State Natural Resources Conservation Council Dept. of Ag. Bldg., Montpelier 05602

Virginia Soil and Water Conservation Council P.O. Box 2148, Richmond 23216

Washington State Soil and Water Conservation Committee General Administration Olympia 98501

State of Wisconsin Soil Conservation Board Soils Bldg., U.W., Madison 53706

Wyoming State Soil & Water Conservation Committee Capitol Bldg., Cheyenne 83001

Virgin Islands Soil Conservation Council P.O. Box 2148, Richmond 23216

State Water Pollution Control Agencies

ALABAMA
Water Improvement Commission
State Office Building
Montgomery, Alabama 36104

ALASKA
Alaska Dept. of Health & Welfare
Alaska Office Building
Juneau, Alaska 99801

ARIZONA
Environmental Health Service
Department of Health
Hayden Plaza West
4019 North 33rd Avenue
Phoenix, Arizona 85017

ARKANSAS
Arkansas Pollution Control Comm.
1100 Harrington Avenue
Little Rock, Arkansas 72202

CALIFORNIA
State Water Resources Control Board
1416-9th St
Sacramento, California 95814

COLORADO
Department of Public Health
4210 East 11th Avenue
Denver, Colorado 80220

CONNECTICUT
State Water Resources Commission
Room 223, State Office Building
650 Main Street
Hartford, Connecticut 06115

DELAWARE
Delaware Air and Water Resources Commission
Loockerman Street and Legislative Avenue
Dover, Delaware 19901

DISTRICT OF COLUMBIA
District of Columbia Department of Public Health
300 Indiana Avenue, N.W.
Washington, D. C. 20001

FLORIDA
Air & Water Pollution Control Comm.
306 W Jefferson
Tallahassee, Florida 32301

GEORGIA
State Water Quality Control Board
47 Trinity Avenue, S. W.
Atlanta, Georgia 30334

GUAM
Public Health and Social Services
Government of Guam
P.O. Box 2816
Agana, Guam 96910

HAWAII
Environmental Health Division
Hawaii Dept. of Health
P. O. Box 3378
Honolulu, Hawaii 96801

IDAHO
Engineering & Sanitation Div.
State Department of Health
P. O. Box 640
Boise, Idaho 83701

ILLINOIS
State Sanitary Water Board
State Office Building
400 South Spring Street
Springfield, Illinois 62706

INDIANA
Stream Pollution Control Board
1330 West Michigan Street
Indianapolis, Indiana 46207

IOWA
Water Pollution Division
State Department of Health
State Office Building
Lucas State Office Building
Des Moines, Iowa 50319

KANSAS
Environmental Health Services
State Department of Health
Topeka Avenue at Tenth
Topeka, Kansas 66612

KENTUCKY
Kentucky Water Pollution Control Comm.
275 East Main Street
Frankfort, Kentucky 40601

LOUISIANA
Louisiana Stream Control Commission
P. O. Drawer FC, University Station
Baton Rouge, Louisiana 70803

MAINE
Water and Air Environmental Improvement Commission
State House
Augusta, Maine 04330

MARYLAND
Environmental Health Services
State Department of Health
2305 N. Charles Street
Baltimore, Maryland 21218
and
State Dept. of Water Resources
State Office Building
Annapolis, Maryland 21401

MASSACHUSETTS
Division of Water Pollution Control
Department of Natural Resources
100 Cambridge Street
Boston, Massachusetts 02202

MICHIGAN
Water Resources Commission
Station A, Steven T. Mason Bldg.
Lansing, Michigan 48913

MINNESOTA
Minnesota Pollution Control Agency
717 Delaware St., S.E.
Minneapolis, Minnesota 55440

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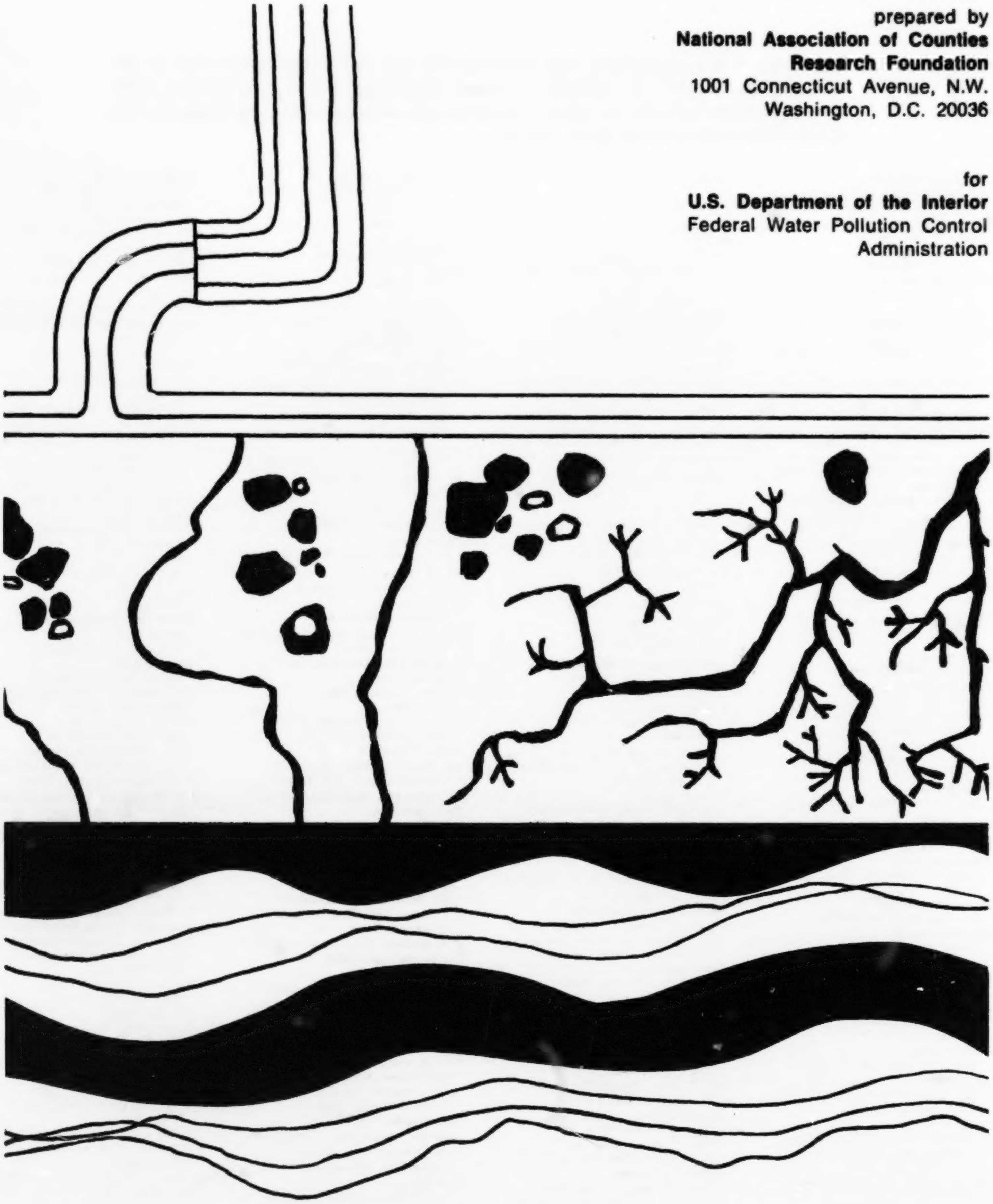

COMMUNITY ACTION GUIDEBOOK FOR SOIL EROSION AND SEDIMENT CONTROL

SECTION IV

RESEARCH NEEDS

Section IV contains a listing of some of the needs for research in urban and suburban sedimentation control that have been noted during the investigations connected with the preparation of this report. The investigations included on-site visits to on-going sedimentation control programs throughout the nation as well as review of the contemporary non-technical literature in the field. In addition, various federal and state agencies were visited throughout the course of preparing this report.

The list is presented in four parts with each part citing needs within a broadly defined "aspect" of sedimentation control. These four aspects are administrative, legal, technical and economic.

Research needs in the administrative aspects of sedimentation control include such considerations as improvements in planning, organizational approaches, communications and information, and others. Research needs on the legal aspects of control addresses such needs as state enabling legislation, local codes, ordinances, administrative rulings, development of model ordinances, and enforcement procedures. Technical research needs include those needs associated with the mechanics of improved detection, measurement, analysis, and control of soil erosion hazards and sediment yields. Research needs in the economic aspects of sedimentation control are directed towards improving the identification and description of all the economic factors associated with sedimentation damages and sedimentation control.

Many of the research needs cited in this report as discreet items are in practice closely interrelated. Therefore, the citation of specific needs should not be judged as being exclusive of related needs cited in other sections, or of those needs which are not cited in this report.

I. Research Needs in the Administrative Aspects of Urban Sedimentation Control

A. Research is needed on the desirability of and the means by which various local public agencies can coordinate their sedimentation control activities on an areawide basis. Such research could lead to the development of model administrative approaches to sedimentation control in urbanizing areas. Research in this area of concern might be designed to:

1) Determine the means by which the sedimentation control activities of state, regional and local agencies can be better coordinated. This would include a study of state government

activities to determine the sources and magnitude of state assistance available to local units of government for sedimentation control.

2) Determine the desirability and means by which the sedimentation control efforts of various local government agencies, such as departments of public works and planning commissions can be integrated with the control efforts of various special district type agencies operating in the same area. Patterns of successful intergovernmental working relationships need to be explored with regard to achieving urban sedimentation control on an areawide (i.e., drainage area) basis.

3) Determine the effectiveness of areawide sedimentation control programs. This may be done, for example, by comparing water management data (e.g., level of water tables, water quality, water quantity, timing of surface and subsurface water yields, flood frequency, etc.) from water management agencies before and after areawide sedimentation control is established.

B. There are many different methods by which local governments in developing areas can introduce sedimentation control planning into other community plans. Research is needed to:

1) Identify those sedimentation control principles, measures, and provisions which are appropriate for various kinds of community plans (e.g., transportation plans, public utility and facility plans and land-use plans) and for various levels of planning (e.g., project level planning, areawide planning, and comprehensive planning).

2) Identify the methods used in developing areas to coordinate plans and programs for storm drainage systems.

3) Suggest how planning methods can accommodate the changing hydrologic patterns imposed upon other planned facilities (such as transportation, drainage systems, and public utilities).

4) Determine what sedimentation control planning activities are being conducted by areawide and regional planning agencies, including councils of government, economic development districts, and sub-state regional planning districts.

5) Explore the various means by which the development process, in terms of its operational sequences, can be reordered for the purpose of sedimentation control.

C. Effective sedimentation control depends upon competent personnel and adequate information. Research in these areas is needed to accomplish the following:

1) Determine the necessary training needed to provide effective inspection personnel.

2) Identify the various administrative approaches that local governments can use to effectively enforce federal and state legislation related to turbidity which affects water quality in local areas.

3) Develop and distribute curriculum materials in sedimentation to be included in overall water pollution control curriculum.

4) Compile and synthesize the research conducted or in the process of being conducted, on urban sedimentation.

5) Explore the means by which sedimentation research can be systematically disseminated, in order that interested parties at local regional, state, and federal levels can maintain an adequate level of knowledge concerning developments in the sedimentation control field.

6) Determine the feasibility and methods of adapting computer technology to the administration, planning, and development of drainage systems in developing areas.

II. Research Needs in the Legal Aspects of Urban Sedimentation Control

A. Research needs to be directed to the legal aspects of local and state legislation related to sedimentation control, including the following:

1) Analysis of drainage ordinances for counties, cities and towns, including preparation of model ordinances appropriate for administration of various local governments and agencies.

2) Erosion and sediment control ordinances with the objective of developing a model ordinance.

3) Analysis of state law relating to sedimentation from development and construction including the preparation of model laws. The study would be designed to summarize state law setting public and private liability for sedimentation damages, as well as state laws designed to abate sediment as a pollutant.

4) Analysis of the Small Watershed Protection Program PL 566 to determine whether it should be amended, and if so, how, in order that it may be more useful under urban conditions.

5) Fixing responsibility and developing methods of assessing sedimentation damages. Analysis is especially needed to determine the feasibility of establishing quantitative

standards for permissible sediment deposition from non-agricultural development, relative to natural levels of turbidity and sediment loads, in stream beds.

6) Developing institutional arrangements for establishing sedimentation control on land being transferred from agricultural to non-agricultural uses. Responsibility for sedimentation control over this land is complicated by the fact that its ownership is often in a state of transition, or is transferred to an absentee titleholder. Questions of legal responsibilities for sedimentation control in these cases are especially in need of research.

7) Analysis of typical zoning ordinance provisions concerning flood plains and drainage, with the objective of summarizing factors to be considered in the preparation of such ordinances.

III. Research Needs in the Technical Aspects of Urban Sedimentation Control

A. Research is needed to develop improved methods for measuring stormwater runoff and sediment yields in areas experiencing development and construction. Improved methods are needed to:

1) Measure runoff and sediment from small areas (several hundred acres).

2) Measure hydrologic conditions at a rate faster than conventional equipment now permits, because of the limited time available for collecting data during runoff periods.

3) Allow integration with existing data collection systems.

4) Separate storm runoff of construction sites from that of non-construction areas.

5) Test the applicability of laboratory conditions to that of natural channels; e.g., test the legitimacy of employing a meandering and overflow stream model to determine the location and kind of deposition in a park or flood plain.

6) Determine the role of soil and vegetation in the hydrologic performance of watersheds and the impact of management practices which change vegetative characteristics.

7) Identify sediment sources.

8) Predict deposition.

9) Distinguish manmade sources of sediment from natural sources under various storm intensities in order that quantitative

sediment yield standards may be established.

B. Technical research is needed on urbanizing watersheds in order that sound drainage principles can be developed related to the changing hydrologic conditions within watersheds undergoing construction and development. Research is needed to:

1) Identify the advantages of vegetated open space, including flood plains, for sedimentation control.

2) Determine the magnitude of sediment yields during measured storms, and measured storm seasons, to be analyzed with various degrees and types of urbanizing activities, to account for the variables attending the urban sedimentation process.

3) Conduct precipitation input studies, including intensive storm input.

4) Collect and analyze runoff data.

5) Measure the effects of sediment on drainage channels.

6) Determine the infiltration capacity of soils within the watershed areas.

7) Analyze the effect of various kinds and extents of vegetational cover.

8) Determine the subsurface drainage characteristics of urban watershed areas, how they are affected by urbanization.

9) Measure slope stability in urban areas under varying conditions.

10) Determine how urban activity affects permeability of soil, and resulting increased runoff and sedimentation.

11) Identify the physical principles underlying the entrainment, transportation and deposition of sediment from lands undergoing non-agricultural development and construction, and sediment behavior in watersheds, lakes and reservoirs. Specifically, the research should have the objective of quantifying the energetics of rainfall action upon soil particle dislodgement and the hydraulic forces moving soil particles over the land surface into waterways. It should seek to quantify (a) the erosivity of rainfall of varying characteristics; (b) the erodibility of subsurface soils varying widely in physical-chemical attributes; and (c) the effects of different kinds of vegetative cover, soil management practices, and engineering installations in modulating the inherent erosivity of rain and the natural erodibility of soils. The research should

also seek to determine the physical principles by which sediment particles move down stream channels, deposit, or continue in transport. A key objective is that of developing engineering procedures that would counteract the adverse effects of the whole array of non-agricultural sediment problems.

12) Determine the rate of return to "normal" of channel cross sections, bed material, and ecology of water channels which have returned to their normal sediment loads after an imposed load.

13) Determine the effects of providing storage upstream, within and immediately downstream of "urbanizing areas to counteract the increase in number and magnitude of stormwater flows created by storm drainage systems and increased imperviousness."

14) Identify the factors affecting the operating trap efficiency of small detention basins designed to trap sediment eroded from urban construction areas, in the interest of improving basin designs for present and future sedimentation control programs. Research would encompass the ratings of sediment detention basins of various sizes and designs. A compilation of data on construction activities and material characteristics of the drainage areas would also be maintained in order to study their effect on sediment production.

15) Obtain a relative measure of the various development and construction activities as contributors to the sedimentation problem, including transportation facilities, subdivision or lot development, industrial and commercial developments, water impoundments and waterway construction or improvements, and service or recreational facilities.

C. There is need for research to determine the behavior of soil and sediment particles within urbanizing watersheds. Research is needed to:

1) Determine the relationship of sediment to the movement of industrial wastes and sewage effluent into streams and lakes.

2) Identify the nutrients other than phosphates that are transported by sediment.

3) Establish knowledge with regard to how the extensive use of pesticides in suburban areas affects adjacent water bodies when transported by sedimentation.

4) Obtain information and facts on the relationship between flocculated sediment from urban development and non-flocculated sediment from the same source. More specific purposes include,

but are not necessarily limited to: obtaining data on the effects of chemical sediment treatment on removing suspended sediment from water; the relationships of the aforementioned conditions and treatment on the impoundment trap efficiency; the distribution of sediment; and the combined effects of treatment, trap efficiency and distribution on maintenance and operation of various elements of recreation facilities, and on turbidity of impounded waters and downstream discharge.

5) Further development in the use of dust palliatives in areas subject to wind erosion.

6) The effects of sediment on water channels as waste carriers and as waste purifiers. For example, determination of the technical relationship between silt and algae; silt and odor; silt and water taste, and between subsoil deposits and dissolved solids yielded to streams.

7) Identify sediment disposition characteristics and patterns at the base of slopes, in rills and gullies.

8) Determine the infiltration capacity of soil types under varying climatic and urban development conditions.

D. Further research is needed which could lead to the development of improved techniques for assessing and controlling urban sedimentation problems. Development needs include:

1) Assessment of the degree of need, cost, and technical feasibility of automatic and semi-automatic sensing and recording devices, under varying urban and urbanizing conditions.

2) Development of protective covers and treatment of soils to avoid expensive sodding practices and to reduce the cost of channel linings.

3) Development of an approach or approaches for assessing the need for various public improvements related to sedimentation control in a given (sediment) problem area.

4) Development of data indicating the limitations and uses of different soils. Solid data is especially needed on soil characteristics meaningful to engineers, architects, planners, developers and construction contractors.

5) A determination of the various types of capital improvements appropriate for areawide sedimentation control programs.

6) Development of effective and economical measures and techniques for temporary erosion control on newly-graded land.

7) The major considerations that should be included in the preparation of effective sedimentation control provisions for master plans adopted by communities for each of the following: drainage control, land use, public facilities, and transportation.

IV. Research Needs in the Economic Aspects of Urban Sedimentation Control

A. Information that has been provided related to the economics of sedimentation problems does not, for the most part, provide sufficient or reliable knowledge with which to conduct adequate analysis of the economic considerations connected with sedimentation control programs. In this regard, research is needed which will accomplish the following:

1) Assess the limitations of using cost-benefit analysis as a criteria for measuring the need for sedimentation control.

2) Develop feasible methods by which cost-sharing can be implemented between state and local governments, urban and suburban communities, private land developers and local governments.

3) Determine alternate methods of financing storm drainage improvements in developing and in developed areas.

4) Develop criteria to determine how to allocate funds and achieve effective sedimentation control under limited-fund situations.

5) Determine the need for and the method by which the federal and state governments can supply financial assistance directly to local agencies to be used specifically for sedimentation control programs in urbanizing areas.

6) Determine the current cost of removing sediment from reservoirs, harbors, lakes, and streams.

7) Compile the cost involved in adhering to sedimentation control principles and measures in subdivision construction activities, in highway construction activities and other transportation related construction associated with public buildings.

8) Identify the costs involved in enforcing sedimentation control ordinances.

9) Determine the economic (and technical) feasibility of introducing sediment control devices into the pattern of construction activities in more strategic sequences in order to achieve sedimentation control.

SECTION IV.

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BIBLIOGRAPHIC:

National Association of Counties Research Foundation, Urban Soil Erosion and Sediment Control, Final Report on FWQA Grant No. 15030 DTL, May, 1970

ABSTRACT

This study was conducted to determine the causes and the extent of urban and suburban soil erosion and sediment problems, and to describe ways in which local communities can organize and implement effective sedimentation control programs. An evaluation is provided on the state-of-the-art of urban sedimentation control, and a series of research needs in the sedimentation field is cited.

In addition, this report includes the "Community Action Guidebook for Soil Erosion and Sediment Control," which describes methods by which local governments can organize, plan, finance, staff, and implement urban sedimentation control programs. Aspects of areawide approaches, legal authority, and public support for sedimentation control are discussed, and an action plan is outlined.

ACCESSION NO.

KEY WORDS:

Sedimentation
Soil Erosion
Sediment
Urban Runoff
Watershed Management
Drainage Control

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1 Accession Number

2 Subject Field & Group

SELECTED WATER RESOURCES ABSTRACTS
INPUT TRANSACTION FORM

5 Organization
NATIONAL ASSOCIATION OF COUNTIES RESEARCH FOUNDATION
WASHINGTON, D.C.

6 Title
URBAN SOIL EROSION AND SEDIMENT CONTROL

10 Author(s)
Powell, Mel D.
Winter, William C.
Bodwitch, William P.

11 Date
May, 1970

12 Pages
97 p

15 Contract Number
FWQA Grant 15030 DTL

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21 Note

22 Citation
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23 Descriptors (Starred First)
Sedimentation, Soil Erosion, Sediment, Urban runoff, Watershed Management, Drainage control.

25 Identifiers (Starred First)

27 Abstract

This study was conducted to determine the causes and the extent of urban and suburban soil erosion and sediment problems, and to describe ways in which local communities can organize and implement effective sedimentation control programs. An evaluation is provided on the state-of-the-art of urban sedimentation control, and a series of research needs in the sedimentation field is cited.

In addition, this report includes the "Community Action Guidebook for Soil Erosion and Sediment Control" which describes methods by which local governments can organize,plan, finance, staff, and implement urban sedimentation control programs. Aspects of areawide approaches, legal authority, and public support for sedimentation control are discussed, and an action plan is outlined.

It was found that soil erosion and sediment in developing areas is extensive, and that these problems pose significant threats to both soil and water resources. While many of the required technical means for controlling sedimentation problems already exist, new administrative approaches are needed which accommodate the diversity of interests and pressures associated with urban and suburban development.

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William C. Winter

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The study was conducted to determine the causes and the extent of urban and suburban soil erosion and sediment problems, and to describe ways in which local communities can organize and implement effective sedimentation control programs. An evaluation is provided on the state-of-the-art of urban sedimentation control, and a series of research needs in the sedimentation field is cited.

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(WRSIC Abstract)
~~(See also W70-06574)~~

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